A GUIDE TO IMPLEMENTATION AND OPERATION OF VEHICLE EMISSIONS INSPECTION CLINICS

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A GUIDE TO IMPLEMENTATION AND OPERATION OF VEHICLE EMISSIONS INSPECTION CLINICS

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SUMMARY

Vehicle emissions inspection clinics are a method of advertising an environmental agency's work in the field of vehicle emissions and their control and for disseminating information to the public. They can also serve as a source of data with respect to the in-use fleet of vehicles in a particular area.

Agencies planning inspection clinics should carefully assess both their objectives and resources and then design a clinic, the level of complexity of which best suits their needs.

Ideas for and suggestions on how to plan, organize and run an inspection clinic are presented in this report. Agencies are encouraged to collect data following the standard format outlined in the text. Standardization of data recording will provide information which is more cross-comparable than may have been the case for previous clinics.

RÉSUMÉ

La mise sur pied de cliniques d'inspection de véhicules automobiles est un moyen de diffuser de l'information au public au sujet du problème des émissions de véhicules automobile, de faire connaître le travail des organismes de défense de l'environnement et d'acquérir des données sur le parc de véhicules en circulation.

Les organismes qui prévoient la tenue de cliniques de ce genre doivent déterminer soigneusement leurs objectifs et leurs ressources et porter leur choix sur le type de clinique qui conviendra le mieux selon leurs besoins.

Nous donnons dans le présent rapport la marche à suivre pour planifier, organiser et tenir diverses cliniques d'inspection. Ceux qui proposent tenir une clinique sont encouragés à suivre le format standard tel que décrit dans les pages suivantes. La standardisation de la prise des données permet de comparer plus facilement les résultats entre cliniques.

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1 INTRODUCTION

In most urban areas, automobiles and light trucks are the source of a large portion of the contaminants, carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO_x), emitted each day into the ambient air. As a result of federal emissions regulations, all new vehicles are equipped with emission control systems to limit the release of these pollutants. However, tampering with these systems combined with neglect and the misfuelling of "unleaded fuel only" vehicles with leaded fuel can result in excess emissions. Misfuelling also results in the release of increased and unnecessary quantities of harmful lead.[9]

A simple vehicle inspection clinic can be used as a method of communicating the benefits of vehicle emission control to members of the vehicle operating public. A clinic is a visible and active tool which can be used to support other more wide - ranging vehicle emissions control-related activities.

This guide is designed to assist environmental agencies in the planning and operation of motor vehicle emissions inspection clinics. The inspection clinic is a proven technique for establishing direct and positive contact with the driving public and the clinics envisioned herein are an outgrowth or progression from the provincial government/Environment Canada Voluntary "Test and Tune" Clinics conducted in this country from 1974 to 1984.

The main difference between an Inspection Clinic and the older "Test and Tune" Clinics is that an on-site mechanic will no longer adjust (or tune) vehicle engine parameters. Adjusting engine parameters has been dropped because of potential liability problems and the advent of more sophisticated, less easily adjusted engine controls. The inspections described in this report are similar to those employed during Environment Week 86[1], the clinic in Brandon in 1987, and the annual Tampering Surveys conducted in the United States by the Environmental Protection Agency, the EPA[2].

Environment Canada encourages agencies to record data following a standard format as outlined in this text so that the information gathered from different clinics will be more cross-comparable than may have been the case in the past.

2 CLINIC OBJECTIVES

Vehicle Inspection Clinics can have a triple purpose of publicizing motor vehicle emissions control systems and their contributions to a cleaner environment; of informing individuals as to the benefits both to themselves and to the environment of improving maintenance and of not tampering with those control systems; plus they can be used to gather data on the status of the emission control systems installed on vehicles of the in-use fleet in a particular area.

3 PLANNING AN INSPECTION CLINIC

The following steps are recommended in the planning and organizing of an inspection clinic:

a) Establish the Objectives - Why are you conducting the clinic?

- information dissemination on motor vehicle emissions problems in order to discourage tampering and misfuelling and to promote proper preventive maintenance.
- public relations for the agency.
- data gathering on the state of emission control systems on vehicles of the in-use fleet.
- all of the above.

b) Develop a Plan

- determine the style of vehicle sampling to be employed. Elements to consider include the size of the expected or desired vehicle sample, funding available, objectives, and personnel available.
- appoint one person to be "in charge" of the inspection clinic and its planning.
- decide on the clinic "level of complexity".
- establish the clinic dates. The season is important. Do not hold a clinic in the winter. Either late spring or summer is best both for the public and the staff.

c) Funding

- confirm that adequate funds have been set aside for the clinic. Include all anticipated rental fees, printing charges, calibration gas costs, insurance costs, advertising expenses, expendables and overtime salaries.

d) Establish PR Links and Begin the Advertising Campaign

- promote as a public service exercise.
- designate a PR person to contact news media. Advertise on the radio, in newspapers (regular and community), and on television, depending upon the budget available.
- contact local law enforcement agencies.
- contact local environmental groups to assist in advertising the clinic to the public.

e) Procurement

- personnel: Arrange for the required number of trained personnel to conduct a clinic of the size envisioned. Because of possible liability problems, only government employees should be used to run an inspection clinic, the exception being personnel employed under contract to the government.
- equipment: Buy, rent or borrow the required equipment. It is best to overestimate requirements and to ensure that equipment is operating and calibrated.
- location: Rent or borrow the best site(s) possible. Check the site several times prior to the start date, i.e., one week before plus 1 day before.
- literature: Have the material you wish to distribute printed or obtain from existing stocks.
- liability: Obtain legal advice and pay liability insurance if required (see Section 3.1).

f) Training

- ensure all personnel are adequately trained. Conduct training sessions as required.
- train personnel as to the content and nature of the survey forms and on how to fill them out.
- set up a mock clinic and drill personnel prior to actual clinic.

g) Mop Up

- ensure the clinic plan includes provision for dismantling the clinic. cleaning the site and collecting the data.

h) Data Gathering, Processing and Reporting

- designate one person to be "responsible" for all data gathering.
- establish the data gathering technique to be employed - handwritten survey forms, computerized, or a hybrid of the two.
- test data gathering system during clinic mock run.
- decide upon the statistics that are to be generated and the facts to be gathered. Select or design the survey form to be used.
- decide what test data is to be provided to the motorist and in what format.

- arrange that all facts and details related to the survey such as the daily temperature, humidity, etc. are recorded.
- write a final detailed report.

3.1 Liability

Because of the volatile climate with respect to liability litigation, agencies planning a test clinic should obtain advice on this topic from their legal advisors during the early planning stages of the project. Some of the areas for potential legal action or problems with respect to liability include:

- traffic accidents involving private vehicles entering or exiting the clinic plus during the inspection process;
- because a test clinic is not a normal activity, special insurance may be required by the management of a shopping centre if a clinic is held on its property. A clinic may not be covered under a general insurance policy;
- fire related to fuel handling;
- equipment damage and damage to private structures;
- post-clinic vehicle problems relating to personnel touching components of a private vehicle that is under test, i.e. during an underhood inspection;
- workman's compensation for all employees;
- summer students and other part-time government employees at the clinic.

Because of possible liability problems, it is felt that only government employees should be used to perform clinic duties and inspections. If a clinic is to be run under contract, the contractor must acknowledge that they are responsible for all liability, both personal and property, with respect to the clinic operation.

4 PUBLIC RELATIONS AND PUBLIC INFORMATION

In the planning of a clinic there are several key decisions relative to public relations. They include: how best to solicit public participation, the information or message to impart to the public, the level of activity at the clinic, and how to involve the media and interest groups. Some of these options are listed below:

a) The Scope of the PR Campaign

Media	Non-Government	Government	Schools
- local newspapers - radio stations - TV stations - community newspapers - printed circulars - bill boards - computer billboards - "Action Lines"	- environmental interest groups - automobile clubs - automobile dealers - automobile associations	- local government officials - local dignitaries - transportation plus environment departments	- high schools - community college automotive training units - university environment and engineering groups

b) Clinic Purpose or Message

- data gathering	- to warn against tampering and misfuelling	- to extoll virtues of emissions control	- to publicize environmental agencies	- to coincide with local automobile show, i.e. the auto and the environment

c) Public Participation Technique

- roadside Sample Selection	- clients are solicited by a media campaign	- mailing campaign to randomly selected participants	- participation via a previously advertized safety inspection program

d) Complexity of Clinic Activity

- information booth	- tailpipe emissions test	- tailpipe emissions test plus a component tampering check	- tailpipe emissions test, component tampering check, diagnostic examination, plus function testing

In addition to the detailed planning, a key to the successful implementation of a voluntary inspection clinic is an effective public information and media advertising program. To attract customers a successful clinic will require a variety of innovative public relations techniques. A creative, well-produced advertising program and a close liaison with the local news media and local civic authorities are essential.(5)

The support and cooperation of the police and special interest groups, especially during the early stages of clinic implementation, are also necessary for large-scale public participation.

Groups to involve in advertising an inspection clinic include:

The Local News Media - An informed press is the best protection against negative publicity, and will influence the population to participate in an inspection program. The local "public interest" or "action line" columnists can have a great influence as was discovered during the 1986 clinic in Vancouver and the 1987 clinic in Brandon. Publicity generated by inviting an "action line" columnist to participate has an added attraction - it is free!

Community Groups - Selected community, professional, safety, environmental and other civic groups can be useful for spreading information and soliciting public participation in an inspection clinic.

Local Government - Local officials should be kept informed of the status of the program, including goals, test dates, locations, etc. Close cooperation with local governmental agencies which may be connected with automobiles and transportation can smooth program operation. Information channels can be opened, contacts established in each agency, and a liaison team established to expedite the free flow of program information.

Auto Sales and Service Industry - As a group which may be affected in the aftermath of an inspection clinic, spokespersons for this group could be contacted and informed of the testing program and of the benefits of an informed public.

Schools - Since one objective of a clinic is to inform the public, future motorists and automobile mechanics are an important audience. Public and high school groups could be invited to observe a clinic in action. Local community colleges with automotive training programs should be encouraged to attend the clinic and to observe clinic activities.

4.1 On-Site PR

Once motorists have been enticed to bring their vehicles to a clinic, it is essential that the opportunity to relay the objectives of the clinic to them is not lost. For this reason a "greeter" for each test lane is felt to be essential.

A "greeter" is a member of the inspection team assigned to meet the motorists when they arrive and to provide the motorists with essential verbal and printed information. The greeters should present the motorist with all of the handouts, buttons. posters and other bumf generated to advertise the clinics objectives. Greeters not only communicate the purpose and nature of the clinic but relay essential information such as: how to proceed into the inspection lane; the safety precautions to be observed; and how long the motorist can expect to wait in line.

All promotional material should be produced well in advance of the clinic and in sufficient quantity to satisfy all participants. If funding allows, the following are effective PR devices: buttons, caps, t-shirts, posters, pens, balloons, or bumper stickers which display the agency's logo or clinic slogan. This material would be provided free of charge to motorists! These PR items would serve as inducements for motorists to bring their vehicles to the clinic. They may compensate for the lack of the free "tune-up" which was formally provided at "test and tune" clinics.

Sufficient on site signs are also essential. One or more large signs should be placed close to the nearest thoroughfare. These signs name the clinic and indicate the entrance. If the clinic is located in a shopping plaza, additional signs inside the building advertising the clinic and its location have proven to be very effective in generating volunteers. One or more large signs indicating the clinic name and the sponsoring agency should be affixed to a clinic structure or vehicle. Be certain to clearly indicate the days and hours of clinic operation.

Again, if funding allows the following could aid promotion of the clinic: large bright flags, large helium-filled balloons, flashing-light mobile signs, music, a hot air balloon (used at the 1986 Vancouver Clinic), and a large van or trailer which displays the agency's logo.

5 PUBLIC PARTICIPATION OR VEHICLE SAMPLING TECHNIQUE

Participation in all of the inspection clinics in Canada to the date of this report has been voluntary. The method for soliciting public participation in these clinics was a limited (by funding) campaign in the local media.

Other techniques which could be employed include:

- flagging down motorists on a street and asking for their co-operation in submitting their vehicle to an inspection. (In their annual tampering surveys, the U.S. EPA normally employs a local police officer to flag down vehicles[2]);
- piggybacking emissions inspections onto a roadside safety check; or
- mailing requests for volunteers to motorists selected from lists of registered vehicles.

5.1 Voluntary Participation Resulting from a Media Campaign

Advantages	Disadvantages
- more publicity and public exposure for the agencies involved. Local environmental agencies are given a higher profile	- the sample is less representative of the in-use vehicle fleet, less random
- an event scheduled for a specific date and location may allow involvement by non-government environmental groups	- more personnel and equipment are required to allow for a potentially large turnouts
- provides for more favourable public reaction - no police involvement plus the public pick their own time to attend	- at the mercy of the weather, rescheduling is difficult
	- the advertising may prove costly
	- more probability of adverse publicity if something goes wrong such as equipment breakdown and long waiting lines

The older "test and tune" clinics relied on an advertised free "tune-up" to encourage volunteers to bring their cars for inspection. The "tune-up" referred to an adjustment of the carburetor to obtain reduced tailpipe emissions. This "tuning" would often result not only in reduced exhaust emissions but, for many older vehicles, could result in noticeable improvements in fuel economy as well. The "test and tune" clinics were usually eagerly received by the public.

However, tuning or engine parameter adjustment of the limited nature which would be possible at most clinics is now discouraged. In many cases adjustment is no

longer possible, since newer automobiles are frequently fitted with sealed carburetors or fuel injection systems instead of carburetors. (Engine parameter adjustment could also require a licensed mechanic in order to comply with some provincial codes.) There are also potential liability problems from dissatisfied customers. Therefore, tuning has been dropped from vehicle inspection clinics.

Several provinces also have anti-tampering/anti-misfuelling legislation with fines for removing or tampering with emission control systems. Public awareness of these fines will discourage many people from attending an inspection clinic particularly if it is a joint clinic with provincial government participation. It was felt that low participation at the clinic in Montreal in 1986 resulted partially from a motorist's fear of being fined.

Suggested alternatives to encourage people to participate in a non-tune clinic include:

- employ a more sophisticated engine analyzer to perform an engine diagnostic check. (Note, however, that smart analyzers are considerably more expensive and more complicated to operate than simpler two gas analyzers);
- include a mechanic's inspection to verify the condition of belts, hoses, fluid levels, lights, and tire pressure. Although a thorough vehicle check would be a great incentive, the drawback is that a detailed inspection could take up to 30 minutes per car;
- provide clients with printed information containing tips on how to operate and maintain their vehicles. (Note: printed handouts of this nature are not available from Environment Canada although they may be available from automobile clubs and automobile manufacturers);
- provide clients with free promotional material such as eye-catching posters, buttons, hats, etc.

Unfortunately, the more features which are offered to attract clients, the more costly a clinic is to operate. Also, a more detailed inspection results in longer test times and requires more personnel and equipment to run the clinic.

5.2 Flagging Motorists to a Roadside Test Site

Advantages	Disadvantages
- potentially provides a more random sample	- less publicity since the selection is random and usually unadvertised

Advantages (Cont.)

- easier traffic control
- timing can be very flexible (stop for lunch or bad weather and clinics can be of shorter duration, 1 day or a few hours)
- no waiting time for the public
- testing can continue until the desired sample size is reached
- smaller crew size since there are no waiting cars to attend
- flexibility, the clinic can easily be moved from location to location
- since there is no rush to clear waiting vehicles. the inspections can be longer and more accurate

Disadvantages (Cont.)

- normally requires the services of a police officer (the agency may have to pay the police officer for his services)
- need a high traffic location for success
- a driver's liability insurance may be void at an off road location. Agency may have to provide liability insurance
- possible public hostility especially if a police officer is employed
- those who deliberately tamper or misfuel their vehicles will normally refuse a test
- one or more equipment trucks are required

The U.S. EPA uses police officers to randomly flag down motorists during their annual tampering surveys. The purpose of the inspection is briefly explained to a motorist after which they are asked if they are willing to volunteer. In the U.S.A. refusal rates have been low, normally less than 10 percent. High refusal rates occurred when a voluntary vehicle inspection was attempted following a mandatory licence and insurance card check plus after a safety inspection[2].

When considering the possibility of using a police officer to flag down motorists, clinic organizers are advised to consider themselves rushing to an important appointment and then realize their feelings if they were suddenly flagged off the road! The agency organizing the clinic could experience some adverse public reaction from the use of a "flag down" style of program.

5.3 Mailed Solicitations and Combinations

Random sampling could be accomplished using vehicle registration data to generate a mailing list to request volunteers. A smaller, fixed-site clinic employing one or two inspectors could then be used. For this test by appointment system, participants could also leave their car at the test centre during the day. The disadvantages to this approach are the loss of publicity and the administration required to prepare and supervise the appointments. Such clinics would also require considerable advanced planning.

Elements of several techniques such as the media campaign and the flag down could be incorporated into a single program. A public information campaign could be run concurrently with a roadside flag down clinic. (This was done in one EPA survey.) Conversely, a roadside check could also be combined with a fixed location information booth. Inspection programs can be tailored to suit budget, personnel and scheduling constraints.

5.4 Participant Volume

For roadside checks or mail generated appointments the volume throughput at a clinic can be controlled as desired but for an advertised clinic the maximum volume can only be anticipated. For the Environment Week 86 test clinics the average number of automobiles tested per day varied from 44 in Montreal to a high of 162 in Vancouver, Table 1. When planning a clinic it is important to realize that an overly successful advertising campaign or a poorly chosen test location may result in long wating lines and adverse public reaction!

The test procedure for what in this report is labelled an "inspection clinic" is faster than for the older "test and tune" clinics since no carburetor adjustments are made. Assuming that a vehicle is already warmed to the operating temperature, the estimated minimum per vehicle test times are as shown in Table 2. However, a word of warning, many drivers who bring their vehicles to clinics wish to "talk" about them. Provision should be made so that the vehicles belonging to these "talkers" can be moved out of the test lane in order to minimize the waiting time of the customers who follow.

Assuming that an exhaust gas analysis plus a complete tampering check and a lead paper test requires a minimum of 10 minutes per vehicle, the throughput for a single lane clinic should be approximately 6 vehicles per hour, 48 per 8-hour day or 240 per 5-day week. In practice, the June, 1986 clinics in Halifax/Dartmouth, Montreal and Winnipeg came closest to this per day volume estimate. The other four clinics had higher rates, Table 1. (Note: not all employed the lead paper test and some where open longer days.)

If a greater volume of vehicles than anticipated results in a long waiting line another inspection lane should be opened. A crew of three could use a back-up gas analyzer and tachometer in the temporary lane. To allow for either equipment breakdown or another temporary test lane, a back-up analyzer and tachometer are essential (see Appendix A for Equipment Requirements).

TABLE 1 MOTOR VEHICLE EMISSIONS INSPECTION CLINICS - JUNE, 1986

Location	Date June 1986	Total Days	Test Lanes	Total Vehicles Tested	Average Cars/ Day	Approx. Cost/ Car*	Contract or Govt. Personnel
Halifax/ Dartmouth, N.S.	2 to 6	4.5	1	248	56	$32	C
St. John's, Nfld.	2 to 6	4.5	2	321	72	$28	C
Montreal, Que.	3 to 5	2.5	2	108	44	$52	G
Winnipeg, Man.	2 to 5	4	1	222	56	$15	G
Calgary, Alta.	5 to 7	3	1	258	86	$10**	PG**
Edmonton, Alta.	1 to 3	3	1	263	88	$12**	PG**
Vancouver, B.C.	2 to 5	4	2 to 3	647	162	$24	C
		Total 25.5		Total 2067	Avg. 81	Avg. $25	

* Government employee salaries not included.
** Provincial government run; their costs are not included.
Note: The vehicle emissions activity in Toronto in June, 1986 was not a true inspection clinic and therefore the data from that area has not been included.

TABLE 2 TIME ESTIMATES

Test			Minimum Time to Complete (Minutes) From	To
A.	-	exhaust gas test - low idle only*	2	3
B.	-	exhaust gas test - low and high idle*	3	5
C.	-	tampering check - underhood and external	5	10
D.	-	A or B plus C	7	10
E.	-	lead paper test	2	3
F.	-	D plus E	7	10
G.	-	function tests	10	15

* Assumes that the test vehicle has been running and is at its operating temperature, that a clip-on tachometer with its own power supply is used, and that the maximum number of personnel are employed.

The "test and tune" clinics always employed 2 lanes so that at least one lane would keep functioning during a lunch break. If a lunch shut down is necessary in a single lane clinic then a sign should be placed at the entrance to indicate the reopening time. One person should stay with the equipment during lunch for security and to distribute brochures to motorists. A lunch break would be an ideal time to refuel the generator, replace analyzer filters, and to recalibrate the analyzers.

However, for continuity and to process sufficient vehicles, a lunch hour shutdown for a single lane clinic is not recommended. Extra personnel should be available to spell key personnel in order to avoid crew fatigue.

6 SITE SELECTION

Weather can be a criteria for selecting a clinic location. Late spring, summer, or early fall are normally the best seasons for clinics to ensure the best weather for the public and the staff. When selecting a location avoid sites prone to high wind and water pooling. A large parking lot is normally selected for a voluntary clinic and a roadside for a flag down clinic.

6.1 Advertised Clinic

Normally located in a large parking lot or similar open space. The prime difference between this style of clinic and a roadside check is that clients are asked to find the test site on their own and are not directed in by a police officer.

The factors affecting site selection include:

i) Easy to locate

- in a well-known location,
- easily seen from adjoining roadways,
- entrance readily accessible.

ii) No traffic jams

- in a parking lot or space that is not normally crowded,
- a straight entrance, drive through and exit is desirable,
- sufficiently removed from local arteries to avoid traffic jams at entrance and exit.

iii) Very large

- for a one lane test clinic approximately 1 acre is ideal[5],
- for a two lane test clinic approximately 1.5 acres[5].

iv) Owner cooperation

- the owner of the site must be in full agreement,
- all insurance waivers or coverage must be provided.

The choice of a parking lot for a vehicle inspection clinic must be researched carefully. An inspection clinic requires a large uncluttered area. A small shopping center such as a "strip mall" with limited parking space is not recommended because of crowding. However, for centres with adequate parking, the presence of the clinic with its

advertising element could draw customers and would probably be welcomed by the centre's management. A shopping centre will usually request the clinic be set up in a remote section of the parking lot to allow shoppers continued access to the most convenient parking spots during the clinic. The remote location will make the use of adequate signs essential for a successful clinic. Traffic control must be arranged so that vehicles can drive into and exit the inspection station easily.

A clinic at a shopping centre requires a large tent to allow testing during inclement weather. It is not wise to cancel an advertised clinic because of adverse weather conditions since such action may upset those who have driven some distance only to find it closed. Warning: during the Environment 86 clinic in Halifax extremely high winds damaged the tent and equipment. Organizers are advised to take precautions and to have readily available the ropes, sandbags and other hardware required to confront such emergencies.

Permanent buildings could be used for this type of clinic especially if bad weather is expected. Adequate parking space would still be required to accommodate waiting vehicles. A permanent building would not only provide weather protection, it would also simplify on-site power supply problems, and would provide easier overnight security for equipment. The difficulty is finding the right building in the right location at the right price.

If a mail campaign is used to solicit volunteers, traffic control is a minor problem since vehicles arrive by appointment only. A small building such as a rental bay in a service station, a government laboratory or an unused factory could be used.

6.2 Roadside Clinic

For this style of clinic a uniformed police officer is normally employed to flag passing vehicles into a roadside location where the clinic is operated from a mobile van. More than one location could be used during the course of the clinic in order to provide a better cross section of the local in-use fleet.

Factors affecting site selection include:

i) Sufficient space for an instrument van and the client's vehicle. A number of alternate sites should be surveyed well in advance of the clinic. Examples are:

- an extra wide shoulder on a roadway;
- a wide boulevard. The California Bureau of Automotive Repair prefers 4-lane

boulevards where they can use one lane for their equipment and inspection station;

- a government vehicle inspection station or weigh station;
- an abandoned service station or other building with a drive through parking lot.

ii) Traffic flow

- sufficient traffic is required to supply a steady stream of clients but do not locate in an area where traffic congestion is common. Avoid rush hour traffic;
- the clinic must not interfere with traffic flow;
- a gradual, low-angle entrance and exit ramp minimizes the chance of accidents.

iii) Inspector and client safety

- sufficient shelter from oncoming traffic to ensure undisturbed clinic activity and to allow safe movement about the test vehicles.

A list of alternate sites should be ready in event of an unexpected disruption on the day of the test. If a potential site is on commercial property, the owner's permission and an insurance waiver may be required. For clinics on city streets obtain authorization from the city traffic department and the police well prior to the clinic.

6.3 Site Security

If an inspection clinic is held out of doors or under canvas, at the end of each test day all equipment should be locked away securely in a van or trailer and if possible the vehicle should be removed to a secure or supervised parking area. Where the vehicle and equipment cannot be easily relocated, a security guard should be hired to stay at the test site overnight.

7 CLINIC LEVEL OF COMPLEXITY

Several factors will determine the type or the level of complexity of a vehicle emissions inspection clinic. The most important include: the purpose or objective of the clinic, the test equipment available, the number of trained personnel to run the clinic, the nature of the test site, the time allowed per test (or the maximum acceptable waiting time for other vehicles in a test line), and the funding provided. Examples of different levels of inspection clinic complexity are illustrated in Table 3.

The inspection clinic activities as listed in Table 3 include:

A) Vehicle Emissions Display Booth

- the display booth is an example of a technique, other than an elaborate (and expensive) outdoor clinic, which could be employed by an agency to reach a large number of vehicle owners.
- the display could range from a simple set of photographs and posters to a more complex arrangement including a display vehicle plus examples of emission control components and technical personnel to explain the benefits of the components to the public.
- the booth could be on-site at an outdoor clinic or separate, in a suburban shopping centre location, or at an auto show. On a weekend a booth would provide an opportunity for considerable public exposure and publicity.
- literature for distribution to the public would be available at the booth.

B) Exhaust Emissions Idle Test

- requires a gas analyzer and associated equipment to sample and measure carbon monoxide (CO) and hydrocarbons (HC) in vehicle exhaust.
- will require a trained operator plus an experienced emissions control person to field public questions.
- idle test results do not relate directly to the federal government mass emissions standards for new vehicles, but it is possible to identify "gross" emitters, i.e. vehicles with serious engine or emission control component problems.

TABLE 3 LEVELS OF INSPECTION CLINIC COMPLEXITY

Level of Clinic Complexity	INSPECTION PROCEDURES OR ACTIVITIES							Minimum* Personnel Single Test Lane
	Vehicle Emissions Display Booth	Exhaust Emissions Idle Test		Component Tampering Check	Lead in Fuel-Misfuelling Checks			
		Low RPM	High*** RPM		Paper	Fuel** Sample	Restrictor	
I	x							1
II		x						3
III		x	x					3
IV				x			x	3
V				x	x		x	3
VI				x	x	x	x	4
VII		x	x	x			x	4
VIII		x		x	x		x	4
IX		x	x	x	x		x	4
X	x	x	x	x	x		x	5

* See Table 4.
** Not recommended unless qualified personnel available.
*** A vehicle should be preconditioned at high idle (2500 RPM) prior to a low idle test[3].

C) Component Tampering Check

- an experienced inspector conducts a rapid visual check of the emission control systems and components on the vehicle in the test lane. The inspection results are recorded on survey forms (Appendix B). It should be possible to identify emission control component tampering (either disconnection, disablement or removal) or the lack of sufficient maintenance. However, be forewarned that for most systems the inspector must touch components, hoses and wiring to ensure they are correctly connected, and this handling of components may result in liability problems if a motorist reports vehicle damage subsequent to the clinic. Because of the wide variety of emissions control components and the differences with respect to location, a very well trained, experienced inspector is vital.
- a tampering check by itself requires neither a gas analyzer nor analyzer operator.
- a tampering check is required in order to identify possible problems or tampering with NO_x and the evaporative emission control systems.
- a simple check for the presence of emission control components does not guarantee that equipment is functioning properly. In order to verify that a component is operating, some form of function test would be required.

D) Lead in Fuel or Misfuelling Checks

- to estimate the possibility that a vehicle is being or has been misfuelled, the U.S. EPA recommends the use of three separate checks on each vehicle they inspect. They feel that any one of the three can be defeated and no single test is conclusive. The checks include a visual inspection of the fuel inlet restrictor, a lead sensitive paper test, and a fuel sample for lead test[2].
- the inlet restrictor inspection is the simplest operation of the three and is normally included as part of a tampering check, C above.
- a lead sensitive paper test is not foolproof but it is a simple procedure requiring care but little training. (See Appendix C)
- the taking and testing of a fuel sample requires training, experience and access to a lead analysis instrument. There are also the dangers which accompany any fuel handling and it should not be attempted by untrained employees. Although included in the EPA tampering surveys, fuel sampling is <u>not</u> recommended for inspection clinics.

7.1 Function Tests - Optional

To ensure that emission control systems are operating correctly it is necessary to perform a function test as well as a visual inspection. For those systems where a simple, field test is possible, an inspector is required to handle certain components and in some cases to disconnect and reconnect hoses. Since an inspector may damage equipment, particularly with older vehicles, the potential for subsequent complaint by a vehicle owner is high. Function tests also require more experienced inspectors and would increase the time to inspect each vehicle.

Function tests and any other checks which involve extensive handling of vehicle components are therefore not recommended.

Items included in this category include:

- EGR valve function test (which requires the use of oil sprays or hose disconnection);
- PCV valve check (which requires the PCV valve to be removed);
- air system vacuum or pressure checks (which require hoses to be disconnected);
- engine parameter adjustments;
- exhaust temperature checks.

7.2 Recommended Inspection Clinics

If information dissemination is the primary objective of an environmental agency then a simple display booth, Level I Table 3, is recommended. The advantage of this technique is that thousands of the motoring public can be reached without the difficult logistics of an inspection clinic.

If a more active profile is desired, but few resources are available, then a Level III clinic, a two-speed (low and high) exhaust emission test, is suggested. This level of clinic provides a rapid throughout of vehicles plus it avoids the liability problems associated with an underhood inspection. Information can be disseminated to the public and data on in-use vehicle exhaust emissions can be collected. The disadvantage of this style of clinic is that if a vehicle's emissions exceed the idle emissions limits, the inspector can say little as to why such a condition exists. If tampering or misfuelling is suspected it usually cannot be detected without an underhood inspection (the presence of the fuel inlet restrictor and the catalyst are the exceptions).

If trained personnel are available then a level IX clinic can achieve goals of information dissemination plus data collection on tampering and misfuelling. This level of

clinic combines a two-speed exhaust emissions test, a component tampering check, and a lead sensitive paper test but avoids the hazards and liability of fuel sampling.

7.3 Idle Exhaust Emissions Limits or Cutpoints

There are no federal standards for idle exhaust emissions test limits for in-use vehicles (either in Canada or the U.S.A.). The difficulty with setting limits arises from the lack of correlation between idle exhaust concentration measurements and the mass emissions measurements required for the "new" vehicle standards (using the Federal Test Procedure, FTP). The latter involves the use of a dynamometer and a constant volume sampling system[3].

The most desireable set of test limits would be those assigned by each vehicle manufacturer. Unfortunately for most makes and models such limits are not available and those which are do not allow for an emissions deterioration (increase) with vehicle age. A set of suggested idle exhaust emission specifications or test limits are presented in Appendix C; they include low idle (low idle speed, curb idle, warm vehicle idle speed) specifications and high idle (2500 rpm) specifications for both total hydrocarbons (HC) and carbon monoxide (CO). The U.S. EPA uses slightly stricter cutpoints for their tampering clinics (2) because the in-use fleet in that country has seen a greater penetration of the more sophisticated closed-loop emission control systems. An indication of the difficulty in establishing idle cutpoints comes from the vehicle emissions Inspection and Maintenance (I/M) programs in the U.S.A. I/M programs in over 50 urban centres in that country employ almost 50 different sets of idle emission cutpoints for their vehicle inspections[4]. For inspection clinics the emission specifications shown in Appendix C are the recommended minimum. Although idle exhaust measurements do not directly relate to a vehicle's mass emissions, they can reliably indicate gross or extreme emitters.

The idle exhaust emissions measurements of CO and HC should be recorded for each vehicle tested. However, in order not to confuse or disillusion the public, it is recommended that the term "failed" not be used in describing a vehicle's test results with the driver. Because of the lack of correlation with FTP measurements it is prudent to be vague when discussing idle test results with a vehicle driver. If a vehicle's idle emissions only slightly exceed the specifications and there is no evidence of tampering or misfuelling then it is best to tell a driver that their vehicle is satisfactory and that from an emission standpoint that the owner is doing a "good" job. If a vehicle's emissions are excessive, at least double the cutpoint, and there is no evidence of tamping or misfuelling, then a driver should be advised that there is a problem and repairs are required. If an

experienced inspector knows what is causing the high emissions, the driver should be informed. . . .

Pass/fail judgements should be reserved for the data evaluation phase of an inspection clinic. After a clinic an investigator can alter pass/fail criteria to ascertain the number of vehicles that "failed" at a particular emission level or cutpoint.

8 OPERATING PERSONNEL

The number of personnel required for an inspection clinic will depend upon the degree of complexity or level of the clinic desired. An estimate of the personnel required for each level of clinic complexity noted in Table 3 is shown in Table 4. The most vital member of the team is the inspector or mechanic (E), without this person a successful clinic is impossible.

The general positions for clinic personnel are illustrated in Figure 1.

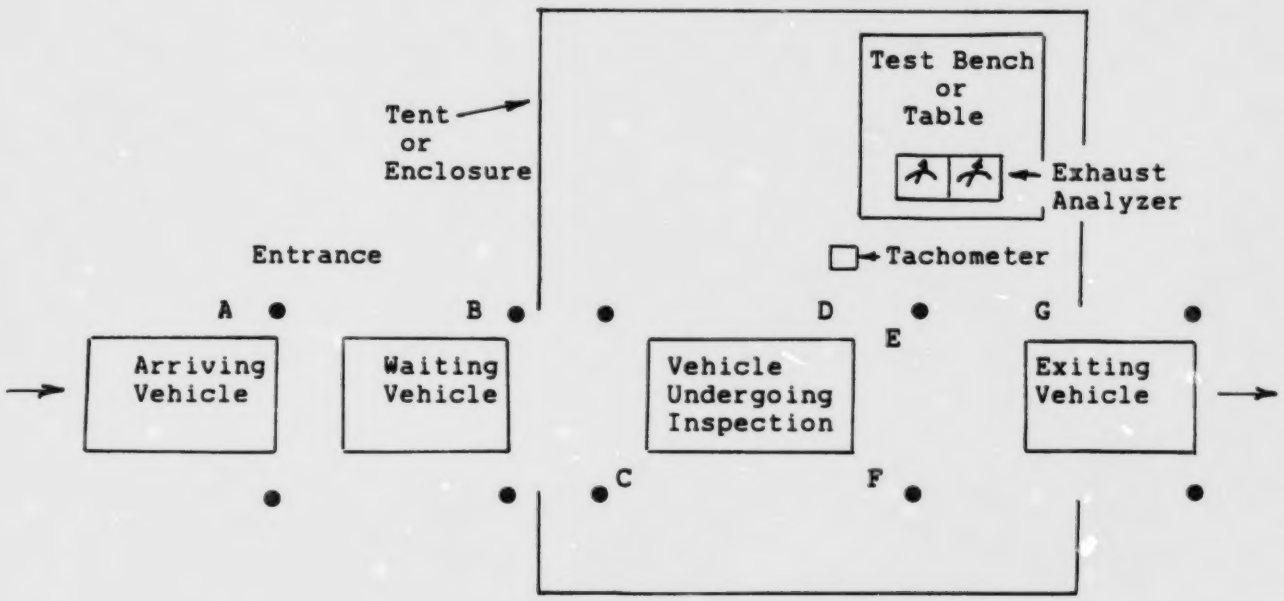

FIGURE 1 EXAMPLE INSPECTION CLINIC SITE PLAN

Personnel

A - Traffic Controller Incoming Vehicles
B - Public Relations - Greeter
C - Analyzer Operator - Lead Test
D - Data Recorder
E - Vehicle Inspector or Mechanic
F - Mechanic's Helper
G - Traffic Control Exiting Vehicles

● - Traffic Cones

Note: For safety reasons it is recommended that waiting cars be kept a minimum of one car length away from the vehicle being inspected.

TABLE 4 PERSONNEL - ESTIMATES

	SINGLE TEST LANE							
*Clinic Level of Complexity	A Traffic Control In	B Public Relations Greeter	C Analyzer Operator-Lead Test	D Data Recorder	E Vehicle Inspector or Mechanic	F Mechanics Helper-Fuel Sampler	G Traffic Control Exit	Minimum Essential Personnel
I		x						1
II	y	x		x	x	z	y	3
III	y	x		x	x	z	y	3
IV	y	x		x	x	z	y	3
V	y	x	x	z	x		y	3
VI	y	x	x	z	x	x	y	4
VII	y	x	x	x	x		y	4
VIII	y	x	x	x	x		y	4
IX	y	x	x	x	x	z	y	4
X	x	x	x	x	x	z	y	5

NOTE: To increase from one to two test lanes would require 2 each of C or D plus E.

* See Table 3.
x - essential personnel - add up to the minimum.
y - non-essential personnel.
z - desirable personnel to ease the strain of long hours and to reduce waiting time.

Obviously the more trained personnel available the speedier the inspection and the more accurate the results plus there is less strain on personnel who are working long hours. An inspection team with high morale is essential for a successful clinic and to present the proper image to the public. Therefore, clinics should only be staffed on a volunteer basis and overtime pay should be offered.

Suggested assignments for each of the personnel illustrated in Figure 1 are described in Appendix A.

If necessary the number of personnel operating a clinic could be reduced to the minimums indicated, Table 4, but the inspection time would be increased, possibly to an unacceptable level if the public turnout is large. Also the accuracy of data gathering will suffer if personnel are reduced to the minimums. If a clinic is piggybacked onto another program involving safety inspections, the personnel requirements would change.

Sources of trained personnel familiar with motor vehicles include local technical high schools and community colleges with auto mechanic training programs. If clinics are planned on a regular basis an agency may wish to arrange for more extensive training for an inspection team. Colorado State University offers a variety of training courses for vehicle emissions instructors and inspectors(6).

It is important to note that a class A mechanic charges a considerable amount for labour. Except under unusual circumstances, the cost of hiring an experienced mechanic for other than a one-day clinic would be prohibitive.

8.1 Other Personnel

If police officers are employed in a roadside flag down clinic then sufficient funding should be set aside to pay for their services.

Funds must also be provided to pay for a security guard to stay at a site and guard equipment overnight.

If personnel from community groups or non-government environmental agencies offer to assist in the inspection clinic, they should be used strictly in a PR capacity and in no way be allowed to work on vehicles at the clinic. These people are not covered for liability and could leave themselves and the government open to litigation should they be involved in a clinic related accident. Non-government personnel should <u>not</u> be employed unless they are under contract.

8.2 Crew Fatigue

A well-attended clinic is labour intensive. Previous clinics have been open for business 8 to 12 hours per day and have run for 3 to 5 days. Although 3 people could test and inspect a vehicle, 4 is the minimum number of personnel per single test lane in order to provide for crew rotation and rest. Most crew positions are easily interchangeable, except for the inspector/mechanic and the strain on this crew member will be greatest. For a team comprised predominantly of office workers who are unused to standing for prolonged periods, a larger crew is recommended. Fatigue can lead to errors and possibly poor liaison with the public, therefore it is recommended that clinics not be open for more than 8 hours each day and that a clinic not be run for more than 5 days in succession.

A two lane clinic with two inspector/mechanics will allow one lane to be shut down periodically during each test day for crew rest.

9 TEST PROCEDURES

9.1 Idle Exhaust Emissions Measurements

The recommended procedures for an idle, exhaust emission, tailpipe test are outlined in Appendix C. Note that for meaningful results a vehicle's exhaust system must be intact and free of leaks!

9.2 Tampering Check

The following emissions control components along with their related hoses and hardware should all be included in a visual tampering inspection:

- Fuel Inlet Restrictor
- Catalyst and Oxygen Sensor
- Positive Crankcase Ventilation Valve (PCV)
- Air Injection Components (Air Pump and Belt or Air Aspiration Components)
- Evaporative Emission Control System (Cannister and Fuel Cap)
- Exhaust Gas Recirculation System and Valve (EGR)
- Heated Air Intake (Air Cleaner, Stovepipe and Thermostatic Control)
- Carburetor (Seals or Limiter Caps) or Fuel Injection Components
- Computer Module and Engine Warning Lights

  Optional:
  - Spark System (Vacuum Hose Routing and Control System)
  - Idle Stop Solenoid or Control.

A description of some of these components is included in Appendix D. Colorado State University has available a VCR tape instruction video and booklet detailing emission control component function and fault-finding inspections[6].

9.2.1 Identification of Emission Control Equipment

At present, in Canada, there is no requirement for manufacturers to list the emission control equipment installed on a particular vehicle or engine family, either on the vehicle or in a document submitted to any government agency. Consequently, in this country, there is no readily available (nor legally binding) means of identifying the components that were on an individual vehicle when it was manufactured.

Therefore, an experienced inspector/mechanic is vital if a Tampering Check is to be performed. This person, relying on experience, should be able to identify

the emission control equipment on most vehicles. N.B.: For a limited number of makes and models an emission control equipment label will identify the emission control hardware originally installed on the vehicle.

For those vehicles which are not equipped with such a label, Transport Canada and Environment Canada have collaborated to produce an emission control equipment list for years 1980 to 1985. Transport Canada also proposes to produce computer generated equipment lists for model years 1986 and later.

For vehicles of model year prior to 1975, agencies may use the Colorado State University listing[7].

9.3 Lead in Gasoline or Misfuelling Checks

In order to correctly identify misfuelled vehicles the U.S. EPA recommends (2) three tests or checks be performed during the same inspection: a check for the fuel inlet restrictor, a lead sensitive paper test and a fuel sample analysis (see Appendix C for details). Fuel sampling is not recommended for inspection clinics unless well-trained personnel are available to conduct the sampling. Fuel sampling also requires a post-clinic analysis of the collected samples.

9.4 Safety

Because an inspection clinic involves the general public operating motor vehicles in a new and unfamiliar situation, it is imperative that all possible precautions be taken to prevent accident or injury both to the participants (and their vehicles) and to the clinic staff. The motto of every clinic manager should be "I never underestimate the ability of people to do something really bizarre!".

Since most clinics are conducted alfresco, with the exception of a tent over top, health problems related to the ingestion of exhaust fumes should not be a problem. However, if by some chance the test area is to be totally enclosed or stagnant ambient conditions are encountered, then a flexible exhaust extension hose should be employed to direct fumes away from the work area.

For safety the following tips or equipment are necessary or should be practiced at all clinics:

- never inspect a vehicle by leaning over the front of the grill, always inspect from the side;
- never lean over the vehicle's fan while inspecting items in the engine compartment;
- a mechanic should not wear a tie or any other dangling apparel or jewelry;

- clearly mark the lane entrance plus a stop point for waiting vehicles. Never allow a waiting vehicle to be closer than one car length to the vehicle under test;
- do not place the tachometer or any other small tools or devices within the engine compartment;
- ask all drivers to place their transmissions in PARK (automatics) or NEUTRAL (standards), to remain in their vehicles and to keep their foot brake applied. (WARNING: the driver could be asked to apply the PARKING BRAKE as an added precaution, but this technique has several drawbacks. The parking brake may not work or if it has not been used frequently, common for automatic transmissions, it may lock or freeze when applied.);
- do not allow personnel to smoke in the test lanes. This is especially important since personnel must remove the fuel cap to check the fuel inlet restrictor;
- when a vehicle is entering or exiting a test lane NEVER allow personnel to stand either in front or behind the vehicle;
- keep an electrical generator and its fuel well away from the test area;
- have the "greeter" and the traffic control personnel wear fluorescent vests or coats.

10 SET UP PROCEDURES

Well in advance of the opening day, all of the equipment and supplies which will be required at the clinic should be assembled in a central location and verified using a check list. A description of the equipment required for a single lane clinic is provided in Appendix A.

The night before an inspection clinic is to open it is wise to block off the site to ensure that the space is open and uncluttered in the morning. If a tent is to be used, erect on the day prior to the start of the clinic. If a generator is used, locate on site and test on the day prior to opening the clinic. Locate the generator where its noise and emissions will be the least obstrusive during testing.

The first operation each morning is to check the oil and fuel levels and to start the generator. Next, station both analyzers (the in-use and back-up) near the test lane, check filters and probes, turn on and warm up. It is important to turn on both analyzers as soon as possible since warm up and calibration will take 20 to 30 minutes. Unless otherwise indicated in the manufacturer's manual, all analyzers should be left on at all times during the clinic day. The minimum calibration requirements are listed in Appendix E.

Check the printed handouts and the survey sheets. Ensure that enough are available for the maximum expected number of clients. Code the survey forms for the day's expected volume of vehicles.

Lay out the traffic control lanes using cones. Erect the signs which indicate the entrance to each test lane. Locate advertising signs in a "best" position at the start of each day.

Noon hour is usually a busy time at most clinics, therefore, on-the-job lunch breaks are recommended especially for the Inspector/Mechanic. Designate a person to obtain lunches and beverages for the rest of the staff.

At the end of each day, site cleanup along with an analyzer check is essential. Store all equipment in the instrument van. It is recommended that when possible the instrument van be removed to a secure parking area each night.

10.1 Clinic by Contract

It may be possible for an agency to contract for the set up and operation of a vehicle emissions test clinic through a private contractor; it will depend upon the expertise of the local contractors and the funds available. Based upon the 1986

contracted test clinics, the cost to provide personnel and to operate a 4 1/2 to 5 day clinic (approximately 9:00 a.m. to 5:00 p.m.) is between $10 000 and $18 000. Usually the agency will still be required to organize and pay for all publicity, provide the literature to be distributed, supply the test equipment, plus supply at least 1 person each day to observe and liaise.

11 DATA COLLECTION

As noted earlier, although inspection clinics can be used as a data gathering tool, their principal purposes are propoganda and information dissemination. If data gathering is the main reason for a clinic then the most valid results would be attained by employing a roadside check which allows for random vehicle selection. Voluntary clinics produce biased results and the use of amateur personnel (i.e., vehicle surveys are not their regular job) can result in data collection errors. If a voluntary clinic is to be used for data collection then the use of standardized survey forms and training sessions for team personnel are recommended.

11.1 Data Sheets - Survey Forms

The U.S. EPA employs a 2 data sheet format in their tampering surveys (2). Theoretically the information listed on each of two separate survey forms is divided so that 4 people can work efficiently on one car, and client waiting time is kept at a minimum. The EPA survey team employs two data recorders, the one stationed near the rear of the vehicle works with the analyzer operator (or fuel sampler) and the one located near the front works closely with the mechanic/inspector.

During the Environment Week 86 inspection clinics an attempt was made to use the 2-sheet, EPA system. However, the EPA forms, which are normally used by a professional survey team, caused difficulties for the less-trained personnel operating the June 1986 clinics. Personnel constraints at most of these clinics also meant that a single data recorder had to fill in two forms per vehicle. This was found to be cumbersome and several clinic organizers reverted to a single data sheet format. The U.S. EPA survey formats were also found to contain many items which were unsuited for simple inspection clinics.

A single data sheet, Survey Form, has been developed and this single data sheet is recommended for future inspection clinics. (Appendix B).

Since every inspector/mechanic will have a preferred order for inspecting vehicle components (and some inspections may be omitted), an agency may wish to design their own form. For example, if a plumbtesmo lead test is not undertaken this item can be omitted from the form. However, for compatibility with the inspection clinic data base (see below), the item numbers, codes and descriptions should remain the same.

11.2 Data Accuracy

If meaningful data are to be derived from a clinic it is essential that the data be recorded as accurately and as clearly as possible. The moto of every data recorder (unless they are lucky enough to have keyboard data entry) should be "I Must Write or Print Clearly at All Times!".

Also, never guess. If either the data recorder or the inspector does not know the answer or cannot find the item, then it is better to leave a blank or to put a question mark than to speculate and record incorrectly. If in doubt, ask the motorist or leave the item blank.

When processing the Environment Week 86 test clinic data many obvious errors or omissions negated the data for many vehicles. For example several recorders forgot to fill in the make and model of vehicle and/or the model year. If these are not recorded then the remainder of the data for those vehicles is useless.

It was also obvious that some recorders/inspectors made incorrect evaluations as to the emission control components originally installed on the vehicles. A discussion of some of the most common anomalies and an indication of the most essential data are presented in Appendix B.

11.3 Information Processing

It is important to assign one individual at each clinic as "in charge" of data collection and of verifying that all sheets or survey forms are completed and correctly coded. If possible a portable computer should be used on site for data collection and retrieval.

A vehicle inspection clinic data base has been created using dBase III+. The items in the data base are numbered and coded as shown in Appendix B. Although it is not essential that items on the survey forms used at a clinic appear in the same order as on the sample in Appendix B, if the existing data base is to be used for post-clinic analysis, then the items should retain the numbers as shown.

12 REPORTING TEST RESULTS TO THE MOTORIST

The personal motor vehicle is a source of great joy or great frustration for many motorists. Therefore, care must be exercised in dealing with and reporting inspection results to the driver who's vehicle is under test.

As noted earlier, since an idle exhaust test is not an accurate measurement of a vehicle's emissions, clinic organizers are discouraged from reporting that a vehicle "failed" an emissions test. More euphemistic phrases which get across the point should be used.

Phrases heard during recent clinics such as: "What a piece of junk!" or "I've never seen anything like this before." should be avoided since they only anger or confuse the public.

If a vehicle exhibits obvious, deliberate tampering the owner should be advised that the tampering is hampering optimum vehicle performance and is also damaging the environment.

The Test Result Report presented to each motorist attending the clinic in Brandon, Manitoba in June, 1987 has been reproduced in Figure 2.

12.1 Information for Public Distribution

Table 5 lists some of printed information available at the time of writing this report. This information is approved for release to the general public. For assistance with material for public distribution contact the Environment Canada Enquiries Centre in Hull, Quebec.

TABLE 5 PUBLIC INFORMATION

TITLE	AGENCY
Fuel Consumption Guide - Latest Edition	Transport Canada
Air Pollution and Your Car-Fact Sheet	Environment Canada
The Car Economy Book	Energy, Mines and Resources

FIGURE 2. YOUR TEST RESULTS*

THANK YOU FOR BRINGING YOUR VEHICLE TO THIS CLINIC!

EXHAUST EMISSION LEVELS:

	LOW	MODERATE	HIGH
HYDROCARBONS (HC)	___	___	___
CARBON MONOXIDE (CO)	___	___	___

POSSIBLE REASONS FOR HIGH EMISSION LEVELS

HYDROCARBON EMISSIONS CONSIST PRIMARILY OF UNBURNED GASOLINE.

High Hydrocarbon emissions may be caused by:

1) Ignition system problems (timing, spark plugs, plug wires, coil, electronic spark control, etc.)
2) Vacuum leak(s) in engine
3) Faulty PCV system
4) Idle mixture too lean or too rich
5) Carbon deposits in engine
6) Worn engine
7) Faulty EGR valve operation
8) Faulty air injection system
9) Faulty catalytic converter
10) Carburetor float height may be incorrect

CARBON MONOXIDE EMISSIONS RESULT FROM THE INCOMPLETE BURNING OF GASOLINE.

High Carbon Monoxide emissions may be caused by:

1) Dirty air filter
2) Plugged PCV system
3) Idle mixture too rich
4) Carburetor, fuel or injection system maladjustment, malfunction or wear
5) Carburetor float height may be incorrect
6) Faulty air injection system
7) Faulty catalytic converter.

IF YOUR CAR HAS HIGH LEVELS OF EMISSIONS, WE SUGGEST THAT YOU HAVE IT CHECKED OUT AT A SERVICE OUTLET THAT IS FAMILIAR WITH THE PROPER MAINTENANCE AND OPERATION OF YOUR CAR, INCLUDING THE EMISSION CONTROL SYSTEMS. A WELL-TUNED CAR NOT ONLY RUNS BETTER, BUT GETS BETTER FUEL ECONOMY. IT ALSO REDUCES EMISSIONS OF HARMFUL AIR POLLUTANTS TO THE ENVIRONMENT.

* AS EMPLOYED AT THE BRANDON, MANITOBA CLINIC, JUNE, 1987.(1)

13 CONCLUSIONS

Inspection clinics are one method of disseminating motor vehicle emissions information to the general public, of advertising an agency's motor vehicle programs and of obtaining data with respect to the in-use vehicle fleet in a particular area.

Agencies planning such clinics should carefully assess their goals and resources and select the level of clinic most suited to their objectives and resources.

For meaningful data collection it is recommended that all personnel undertake some form of training and that standard data survey forms, such as presented in this report, be used.

14 REFERENCES

1. "Auto Test 86", Halifax/Dartmouth Test Clinic CES, 30 July, 1986; "Winnipeg Vehicle Emission Test Program - 1986", Youmans, T., Environment Canada, W&NR 86/87-CP(EP)-8, September, 1986; "Vehicle Emission Test Program - Brandon 1987", Youmans, T., CP (EP) WNR - 87/88-6, February, 1988.

2. "Motor Vehicle Tampering Survey - 1986", U.S. EPA, September, 1987.

3. "I/M Short Tests and Cutpoints for 1981 and Newer Emission Control Technology", Duleep, K.G., et al, SAE 851185, May, 1985.

4. "An Introduction to Motor Vehicle Emissions Inspection and Maintenance Programs", Cope, D., Environment Canada Manuscript Report, IP-75, September, 1987.

5. "Design and Implementation of Vehicle Safety and Emissions Inspection Programs - Volume 1", United Technologies Hamilton Test Systems, 1985.

6. "Emissions Control Systems Identification and Tampering Detection - A Reference Guide", Colorado State University, 1980.

7. "1966-1986 Automotive Emission Systems Applications Guide", Colorado State University.

8. "A Report with Recommendations for the Reduction of Emissions from In-Use Light Duty Motor Vehicles", Environment Canada, IP-34, May, 1985.

9. "Vehicle Emissions Control System Tampering", Cope, D., Environment Canada, EPS 2/TS/6, March, 1988.

APPENDIX A
PERSONNEL AND EQUIPMENT FOR A SINGLE TEST LANE

APPENDIX A

A.1 EQUIPMENT FOR SINGLE TEST LANE

Items A, B and C are only required if exhaust gases are to be measured. Cost estimates have been included as a guide only. Prices will vary regionally across Canada.

A) Exhaust Gas Analyzer (suggest two for a single lane clinic, three for a two lane clinic)

- for inspection clinics, particularly roadside mobile tests, an "EPA 75" or equivalent two gas analyzer is sufficient (Appendix E). These instruments are smaller, less expensive and less complex than the four gas analyzers used for research and engine analysis.
- these instruments are not normally carried by equipment rental companies. Possible sources for borrowing this equipment include: schools with automotive courses, automobile dealers, service stations, or the instrument suppliers. For all clinics at least one spare analyzer is recommended as a back up in the event of equipment failure.
- use a wheeled table to hold the analyzer.
- spare parts which should be brought to the site include:
  - filters - allow 2 or 3 for each analyzer for each test day.
  - flexible exhaust probe, sample line and assorted connecting tubing.
  - obtain a special, thin probe for trucks with flash arrestors.

Cost: - the purchase price for a 2 gas analyzer is approximately $4000.
- not usually available for rental.

B) Calibration Gases (for further discussion see Appendix E)

- suggest performing an electronic calibration and zero check using the instrument fitted controls two to three times a day, plus a span check with a calibration gas each morning after the analyzer has warmed to operating temperature. Do not turn the analyzer off during a test day unless it is so recommended in the manual or servicing is required.
- for the field obtain a lecture bottle size or larger of:

- 1.6% CO, 320 ppm HC, Hexane or equivalent, in N_2. Hexane equivalent is usually propane, i.e. for a hydrocarbon analyzer 600 ppm propane is approximately equivalent to 300 ppm hexane.

- for a laboratory calibration three span gases are recommended.

Cost: - Per cylinder is $500. Check regional suppliers. The analyzer sales representatives in your area are a likely source of span gases. Since these gases are normally a special order it is best to ensure that they are delivered at least one month in advance of the clinic.

C) Tachometer (minimum of two per single lane clinic)

- an induction coil type which quick-connects around high tension spark plug wire is the easiest to use. This style eliminates the need to electrically connect the unit to the vehicle.
- an external power supply, either batteries or a plug in unit, is recommended. Do not use the vehicle's battery to operate.
- use a separate stand or table so that tachometer and batteries do not sit on the vehicle under test.
- an analog dial may be easier to read in sunlight.
- always have at least one spare tachometer to back up the one in use.

Cost: - to purchase is approximately $600.
- bring an adequate supply of batteries, estimate $15 per test day.

D) Tailpipe Lead Check Equipment

- lead test paper - 1 1/2 boxes of 40 paper strips per box minimum per lane per test day - suggest 8 boxes for a 5 day clinic.
- distilled water - 4 litres (plus container).
- 2 x squirt bottle - 1 litre.
- clothes pins or some other, cheap, disposable clamp.
- disposable plastic gloves. These are used to prevent spreading lead contamination to unused paper.

Cost: - 1 box of 40 lead test paper strips is approximately $25 (1988). Plumbtesmo is a trade name of the most often referred to lead test paper (Appendix C).
- water bottles should be available from agency supplies.
- fund clothes pins and gloves from the budget of item M.

E) Instrument Van

- to transport equipment requires a full-size panel van.
- use the van as a lockable overnight storage for equipment.
- using a van will reduce set up time and the possibility of equipment damage.

Cost: - suggest using a government vehicle when possible.
- rent a truck at $30 to $60 per day.

F) Vehicle - Personnel Transport

- to transport staff and to run errands.

Cost: - suggest using a government vehicle.
- rent a truck at $30 to $60 per day.

G) Tent(s)

- for a parking lot style clinic, in case of inclement weather, a large tent(s) or marquee with removable sides is essential. A suggested minimum size is 20 ft. x 20 ft. for a 1 lane clinic and 20 ft. x 30 ft. for a 2 lane clinic. The tent should be large enough for cars to drive through and still accommodate all test equipment and personnel. An open side tent with large awning could be used. WARNING - High winds during inspection clinics have caused serious problems and damage to facilities. Be certain to stock and use tie down ropes and sandbags!

Cost: - tent rental, approximately $50 to $100 per day.
- ropes and sandbags should be available from agency supplies.

H) Traffic Control

- fluorescent vests - minimum of two.
- 2 x wooden horses to block off the test lane when not in use.
- traffic cones minimum of 10 (see Figure 1).

Cost: - borrow the cones and horses.
- vests range from $10 to $30 depending on quality.

I) Safety Equipment

- safety glasses are required for the inspector and the data recorder if test vehicles are to be run with the hoods open.
- a sign stating "Drivers please remain in your vehicle".

- all personnel should be requested to wear safety boots.
- first aid kit.
- fire extinguisher - Type B and C.
- ear muff style hearing protectors - 2 pair, one for the inspector and one for the data recorder.

Cost: - suggest borrowing the fire extinguisher and the first aid kit.
- personnel should supply their own safety boots.
- safety glasses cost approximately $10 a pair.
- ear muff hearing protectors - $30 a pair.

J) Data Handling

- 2 x portable hand calculator.
- clip boards - 5 minimum.
- 2 x 3 ring binders for survey forms.
- pencils, pens, markers, sharpener.
- pad paper.
- data sheets, 1 or 2 per car depending upon system.
- 1 x portable computer - optional.

Cost: - most of this equipment should be available from government supplies.
- portable computer - rental at $200 per week.

K) Clothing

- recommend each team member have a clean set of overalls or lab coat each day. A "throw away" style of coverall is available.
- working gloves - minimum 7 pairs.
- extra overalls for visiting dignitaries - minimum 2 pairs.

Cost: - overalls cost up to $30 per pair. The "throw away" style cost approximately $5 each.
- gloves at $2-$5 per pair.

L) Rain Gear

- minimum 4 pairs, pants plus jacket and hood.

Cost: - up to $30 per set.

M) Small Tools

- trouble light with a 15-metre cord.

- screwdrivers (assorted).
- mirrors with extension handles (for catalyst search and to locate any other inaccessible hardware).
- rolls of string, masking tape, duct tape and cello tape.
- pliers.
- pocket knife.
- coat hangers (wire).
- leaded fuel nozzle to be used as a gauge for filler neck.
- camera - for historical record and PR purposes.
- 2 fender aprons.
- clothes pins-100.
- lawn chairs, one per team member.
- oil in spray can for use with function tests only.
- tire pressure gauge.
- rope and sandbags - to weigh and tie down the tent and other equipment in high winds.
- flashlights and batteries.
- hand vacuum pump and fittings (function tests only).
- 3-foot step ladder.

Cost: - most of this equipment should be available on loan or from agency supplies.
- include $200 in the clinic budget for minor purchases plus the other small items in sections D, M and N.

N) Miscellaneous

- rags.
- hand cleaner.
- paper towel.
- garbage cans and plastic garbage bags.
- if site is in a remote location it may be advisable to rent a "Johnny On The Spot" for both staff and clients.
- cooler for drinks and lunches.

Cost: - see budget item M.

O) Power Source

- a power outlet or hookup is required close to the test lane (within 30 feet), 1500 watts minimum.
- if no power hookup is available then a generator is required, 1500 watts minimum. A generator mounted on wheels is recommended. Remember that a portable generator requires maintenance, and fuel plus it presents a noise problem and a potential fire hazard.
- 1 x heavy, exterior-use extension cord, 15 amp rating, to distribution bar (4 outlet), minimum of 30 m. long.
- 4 x lighter, exterior-use extension cords, 7 m. each, minimum.
- a voltage regulator may be required if long extension cords are employed. This could be required for both a generator or a system hooked to an electrical outlet.
- for a single test lane sufficient power is required to run 2 analyzers, a trouble light for underhood inspections plus power for the tachometer.
- provide a minimum of 4 litres of oil for generator plus sufficient fuel in an approved container.

Cost: - suggest rental if a generator is required.
- 1 x 30-metre extension cord, $30.
- 4 x 7-metre extension cords, $15 each.

P) Fuel Sampling - Apparatus

- containers with labels.
- siphon.
- unleaded gasoline in approved containers to flush siphon and to replenish fuel removed from a client's vehicle.
- 2 x 5 gallon gasoline containers.
- 1 x 1 gallon gasoline container.
- extra "no smoking" sign for fuel storage area.
- extra fire extinguisher - Type B.
- secure storage for samples.

Cost: - most Environment Canada Regional Offices should have a fuel tester kit.
- an extra liability insurance cost may be incurred if fuel tests are required.

Q) Compressor - Optional

- to increase tire pressure as a service to the vehicle operator.
- requires access to a power outlet.

Cost: - rental, $50 per day.

R) Signs

- 1 x "Drivers Please Remain in your Vehicles" sign.
- 2 x "No Smoking" signs.
- minimum of 2 clinic advertising signs, 1 metre square - minimum size. Ropes and nails to hang the signs are also required.
- "entrance" sign, one for each test lane.
- large flashing-light sign, if funds permit. Power source required.

Cost: - suggest making the signs by hand or rental.

A.2 PERSONNEL FOR A SINGLE TEST LANE

The positions described correspond to those listed in Table 4 of the main text.

A) Traffic Control In - (Incoming Vehicles)

Duties

- ensures that motorists are directed into clinic entrance,
- controls parking,
- advises of delays, etc.,
- the test procedures (Appendix C) require that the test vehicle exhaust system be checked for major leaks since a vehicle with a major exhaust leak cannot be tested for idle exhaust emissions. The Inspector (E) or Analyzer Operator (C) would normally check a vehicle's exhaust system for leaks (usually evident from a loud noise). However, if a number of vehicles are waiting to be tested, it may save driver frustration by having (A) (or (B)) check for leaks. If a leak is detected. (A) informs the motorist that their vehicle cannot be tested and they are spared a long wait for naught.

Training

- minimal, could use a student.
- if the roadside flag down technique is selected as the sampling method then a police officer usually provides traffic control.
- Note:- Some general vehicle emissions training could be required if A, B and G are to be interchangeable.

B) Public Relations - Greeter

Duties

- welcomes the participants,
- explains the program and its objectives,
- hands out any literature and other promotional material,
- explains to the driver what will happen in the next few minutes,
- asks permission to inspect and has a waiver signed (if required),
- discusses motor vehicle emissions in general with the driver,
- instructs each motorist on where to stop for the inspection and to leave their car running with the transmission in park or neutral,
- asks the driver to open, or release, any inside hood latch (if an underhood inspection is included),
- requests drivers to remain in their vehicles for safety reasons and to keep the pedal brake applied at all times during the inspection,
- handles and records any complaints or suggestions,
- could run an information booth if one was included with the clinic program.

Training

- a general knowledge of motor vehicle emissions, emissions test procedures, agency policies and clinic objectives is essential. Would refer detailed technical questions to the Inspector (E).
- minimum, one-day refresher course required.

C) Analyzer Operator - Lead Test

This operative would be required if a clinic included a lead sensitive paper test. Also if the Data Recorder (D) were not available, (C) could assume the duties of Data Recorder. If (C) is not included on the clinic staff the Inspector (E) assumes the analyzer and inspection duties and (D) performs the data recording functions listed below.

Duties

- responsible for the calibration and operation of the exhaust gas analyzer plus handling the calibration gases and associated equipment,
- performs the tailpipe lead sensitive paper test,
- inspects exhaust system for leaks prior to test,
- inserts and removes analyzer probe from the vehicle tailpipe,
- depending upon the nature of the clinic could also perform the following inspections or tests:

- catalyst presence on the vehicle and its condition,
- gasoline cap integrity,
- fuel inlet restrictor check.
- check for an unleaded fuel label on the fuel inlet.

Training

- an experienced air pollution technician or a vehicle mechanic is desirable.
- an alternative is a one-week exhaust analyzer training program.
- must be familiar with the survey forms which could require a one-day training course.

D) Data Recorder

Duties

- responsible for data gathering for the clinic,
- records all information as required on the vehicle Survey Forms (Appendix B),
- questions the vehicle operator with respect to any vehicle information not readily available on fixed labels,
- records the Inspector's (E) assessment of the state of components during the Tampering Check,
- records the exhaust analyzer readings,
- prompts the inspector as required.

Note: Would assume the recording duties of (C) if the clinic does not include that member on the staff.

Training

- must be familiar with motor vehicle emissions control equipment, but extensive technical background not a prerequisite.
- must be familiar with the requirements of the survey forms and with the terminology on those forms. Three-day training course which includes a practical session is recommended.

E) Vehicle Inspector or Mechanic

Duties

- responsible for the analyzers, the Tampering Check and all technical aspects of the clinic,
- asks whether the parking brake has been used regularly and if so. asks that the parking brake as well as the pedal brake be applied,

- instructs a motorist to start and stop the vehicles engine as required,
- answers all technical questions referred by other personnel,
- connects tachometer if required,
- requests motorist to speed engine to 2500 ± 100 RPM or performs the same function under the hood if required,
- instructs the data recorder when to record analyzer readings,
- informs the data recorder as to the status of each component on the Survey Form,
- performs component function tests if required,
- if personnel are limited the Inspector/Mechanic performs all analyzer duties and technical tasks assigned to the Analyzer Operator, (C).

Training

- the Inspector is the most vital member of the team. It is essential that this individual be either technically oriented with considerable experience in vehicle emissions and control systems or a licenced mechanic with emissions control system experience.

F) Mechanics Helper - Fuel Sampler

Duties

- assists the inspector (provides tools, etc.),
- depending upon the nature of the clinic could perform some of the inspections or tests assigned to (C) and (D),
- if fuel sample is to be taken this team member is required to draw a fuel sample from all unleaded fuel indicated vehicles (only performed when the vehicle is stopped and the engine is shut off). This person will then either catalog the sample or perform an on site analysis. They are also required to replace the fuel if requested by motorist.

Training

- minimal unless a fuel sample is taken then a highly trained technician is required.

G) Traffic Control Exit - (Exiting Vehicles)

Duties

- similar duties to (A). Could be considered a spare to fill in as needed,
- may not be required if clinic exit is unobstructed.

APPENDIX B
SURVEY FORMS OR DATA SHEETS

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SURVEY FORMS OR DATA SHEETS

B.1 EXPLANATION OF SURVEY FORMS

The survey form presented in this Appendix, Figure B.1, is modelled on those forms used by the U.S. EPA for recording vehicle survey data in the field[2]. However, the EPA survey teams prefer a two-form system, one for a data recorder at the rear of the vehicle and the other for one at the front. During the Environment Week 86 inspection clinics most organizers found a two-form system awkward and reverted to a single page for data collection. Many also felt the EPA forms contained several redundant, confusing and unnecessary items. An attempt has been made to incorporate into the present format the suggestions received subsequent to the June, 1986 clinics and the clinic in Brandon. Manitoba in June, 1987.

In order to analyze the data from the '86 and '87 clinics, a microcomputer data base was created using dBaseIII+. The titles, numbers and codes shown herein were used in establishing that data base. Although it is not necessary to include all of the items listed on a clinic survey form (nor must they be in the order shown), it does ease subsequent data collation if the same numbers, titles and codes are retained in the final survey form.

The items, as numbered on the forms, are described in Section B.3.

B.1.1 ESSENTIAL DATA

There are several items on these survey forms which are essential for post clinic data analysis. The accuracy of original emission control equipment identification cannot be verified without this information. The essential items include:

No. 1 - MAKE - the manufacturer's name (e.g. Toyota) or the name of a major company division (e.g. Buick).

No. 2 - MODEL - although not as essential as item no. 1, the correct identification of the model (e.g. Capri) can aid data verification.

No. 3 - MODEL YEAR - since the emission control technology installed on new vehicles can change from one year to the next, the information recorded for each vehicle is useless without the model year.

No. 10 - DISPLACEMENT - the emission control equipment installed can also vary with engine size within a particular model year.

No. 14 - TRANSMISSION - as for engine displacement, the emission control equipment installed can vary with the type of transmission installed on the vehicle.

No. 18 - CARBURETOR BARRELS -
No. 21 - FUEL INJECTION
No. 22 - TURBO

these three items must also be specified in order to correctly identify emission control components.

Note: The Vehicle Identification Number, VIN (No. 12) and the Engine Family Code, (No. 13) are also very useful in vehicle equipment identification but they are often difficult to locate and record accurately.

B.2 COMPONENT CONDITION CODE

To ease data processing and recording, codes have been assigned, Table B.1. Codes are also used to identify the observed status of the components listed on the Survey Forms. The numeric codes shown are similar to those used for the U.S. EPA tampering surveys. Note: to speed data entry the "Y" code for "Yes or component present with all connections in place" could be entered with a check mark.

Most of the codes which apply to a particular item are contained within brackets on the Survey Forms. Personnel with limited training should record in plain language rather than misuse these codes.

B.2.1 TIPS AND COMMON ERRORS

The following are either tips for identifying emission control components or examples of areas where data recording errors are common. They originated from experience gained in attempting to decipher the June, 1986 inspection clinic data sheets.

- Model Year - since motorists may not know the correct model year of their vehicles, especially if they were purchased either used, or early or late in a calendar year, use their information as a last resort only. For 1980 and newer vehicles, the model year can be determined from the VIN but only if that number has been correctly recorded. Another source for the correct model is the manufacturer's door post label. (See Section B.3, item 12.)

TABLE B.1 SURVEY FORM CODES -- (Maximum field width is 3)

Code	Title	Comment
N	= No or None or Negative	-
Y	= Yes or Component Present	- A check mark could be used
0	= Not originally equipped	-
1	= Correct function verified	- Some function test performed
2	= Electrically disconnected	- Wire removed or broken
3	= Vacuum disconnected	- Hose missing or holes in line
4	= Mechanical disconnect	- Parts unhooked, unbolted, cut
5	= Incorrectly routed hose	- Hose connected to wrong port
6	= Modification	- Not per original specs
7	= Removed or Missing item	- Definite TAMPERING indicated
8	= Misadjusted (away from spec)	- Includes a loose belt
9	= Malfunction + Deterioration	- + Corrosion &Obscured label
?	= Cannot Determine or Find	- Use when uncertain
2W	= Oxidation - 2 Way catalyst	- As indicated on label
2W3	= 2 Cats, 2 Way + 3 Way	- As indicated on label
3W	= Ox/Reduction -3 Way catalyst	- As indicated on label
99	= Rotary Engine	- Number of cylinders (No. 11)
A	= Alcohol + Gasoline Blended	- Specify with comments No. 44
AL	= Alcohol blend + Leaded	- Driver alternates fuel used
AU	= Alcohol blend + Unleaded	- Driver alternates fuel used
A2	= Automatic Transmission -2spd	-
A3	= Automatic Transmission -3spd	-
A4	= Automatic Transmission -4spd	-
AO	= Automatic Trans + Overdrive	-
AT	= Automatic Transmission	- Use if speeds unknown
B	= Non-stock equipment	- Not as originally on vehicle
C	= Car	-
CNG	= Compressed Natural Gas	-
DF	= Diesel fuel	-
D	= Equipment Add-on to vehicle	- Not on vehicle originally
EL	= Exhaust system leaks	- Includes muffler, cat, pipes
F	= Fuel Injection	- FI but type unknown
H	= Hybrid	- An add-on or strange design
INV	= Inverted Air Cleaner Cover	- A form of tampering
L	= Leaded fuel	-
LC	= Limit Caps on the carb adjust	- Caps originally fitted
M	= Neat Methanol fuel	-
M3	= Manual Transmission -3 speed	-
M4	= Manual Transmission -4 speed	-
M5	= Manual Transmission -5 speed	-
M8	= Manual Transmission -8 speed	-
MT	= Manual Transmission	- Use if speeds unknown
MC	= Motor Cycle	-
MP	= Multi-Port fuel injection	-
NL	= No Label on the vehicle	- No emission component label
NP	= Negative Plumbtesmo test	- Lead paper tests negative
ON	= Engine Check light is ON	- As observed by inspector
P	= Stock part	- Replaced as per original
PP	= Positive Plumbtesmo test	- Lead paper test positive
PR	= Propane fuel	-
RAF	= Requires New Air Filter	- Maintenance Assessment, No. 55
REM	= Requires Engine Maintenance	- Maintenance Assessment, No. 55
RFM	= Requires Air/Fuel Adjust	- Maintenance Assessment, No. 55
S	= Seals on the carb adjusts	- Seals originally fitted
SPD	= Stove Pipe is incorrect	- Missing, disconnected, holed
T	= Truck	- List jeeps and small vans as trucks
TB	= Throttle-Body fuel injection	-
U	= Unleaded fuel	-
UL	= Unleaded + Leaded	- Driver alternates fuel used
Z	= Other (add comments No. 44)	- Add note in comments No. 44

- Catalyst/Restrictor/ Tank Label - If a vehicle was originally equipped with a catalyst it must also have been equipped with a fuel inlet restrictor and a "unleaded fuel only" tank label. Unfortunately the converse is not always true. Some vehicles which do not have catalysts originally installed do have tank labels and inlet restrictors and are designated "unleaded fuel only" by the manufacturer (see Section B.2.2).
- Dash Label - Government agencies, both in the U.S.A. and Canada, removed the legal requirement for an "unleaded fuel only" label on the dash in 83/84. Therefore many vehicles may not have been equipped with a dash label even though designated "unleaded fuel only". The lack of a dash label does not necessarily indicate tampering.
- Mileage - Do not rely solely on the odometer reading when recording vehicle mileage, especially for older vehicles. Ask the motorist if they know the correct mileage, i.e., an older vehicle may have 160 000 miles not 60 000.
- Tank Label - The "unleaded fuel only" label may not be affixed to an outside vehicle surface, it may be inside a covering door. Ask the driver for his fuel tank key and look!
- Carburetor Seals and Limiter Caps - Although the U.S. EPA required all 1982 and later model year vehicles equipped with carburetors to limit adjustments, seals are not a legal requirement and there is no legal restriction against their removal. The seals (or limiter caps) may be missing from a carburetor, but a visual inspection and idle test cannot establish whether the parameter adjustments are correct. Consequently, the EPA considers seal and limiter cap removal as "arguably tampered". Also, although seal removal can be detected by inspection, it is not as easy to identify limiter cap removal and there is no list of vehicles originally equipped with caps.

- Do not class limiter cap removal in 1973 and older vehicles as tampering since it was a common practice for dealers to remove the caps prior to sale.
- The Canadian federal motor vehicle legislation does not require vehicles with carburetors to have seals.

B.2.2 THE MISSING CATALYST

The need for an experienced, knowledgeable inspector/mechanic has been stressed throughout this report. A person with emission control system familiarity is important in order to identify the control components on each vehicle. However, it is equally important to recognize that certain components may not be missing, but rather that they were never original equipment on many models.

For example Canadian Specification Chryslers fitted with a 2.2 litre engine had no catalyst and were designed for leaded fuel use, up to and including the 1984 model year. Beginning with the 1985 model year these same vehicles (a group which includes most of the K cars) were equipped with a catalyst, a restrictor and a tank label. These same vehicles in the USA have had catalysts installed since the 1981 model year. Similarly all Canadian Specification Chrysler 2.6 litre engine vehicles, until the 1988 model year, have no catalyst, no restrictor and no tank label. Also note that the 1984 and older Chrysler 2.2 engine vehicles have a "resonator" installed where the catalyst would go; this component is sometimes incorrectly identified as a catalyst.

The emission control system differences between many Canadian and U.S.A. Specification vehicles arise because the Canadian "new" vehicle emission standards have been less strict since 1975. The difference in standards has made it possible for many vehicles to meet the Canadian standards without the assistance of a catalyst. This has led to the apparent phenomenon of the "missing catalyst".

Some manufacturers with vehicles designed with a catalyst in the USA have decided not to install a catalyst on the same models when sold in Canada. However, they still feel that those vehicles will perform better on unleaded fuel. Consequently there are many vehicles in Canada that are designated "unleaded fuel only", carry a tank label and an inlet restrictor, but were not originally fitted with a catalyst. The list of such vehicles is too long to reproduce but examples include Toyota Tercels, AMC Jeep C37s, GM Celebrities and Pontiac Sunbirds.

80. NUMBER: _____ 90. DATE: _____ 100. LOCATION: _____ 110. INSPECTOR: _____

1. _____ MAKE
2. _____ MODEL OR SERIES
3. _____ MODEL YEAR
4. _____ LICENCE PLATE (PROVINCE)
5. _____ VEHICLE TYPE (C = Car, T = Truck)
6. GVWR: 6a. _____ lbs _____ Kgs
7. _____ ODOMETER x 1000. 7a. _mi _km
8. _____ DASH LABEL (Ø,N,Y,7,?)
9. _____ FUEL USED - ASKED MOTORIST (L, U, UL = Combination, A = Alcohol blend, AL, AU, CNG, DF = Diesel, M, PR = Propane)
10. _____ DISPLACEMENT 10a. ____CID ____ LITRES
11. ____ NUMBER CYLINDERS (1,2,3,4,5,6,8,10,12,99 = ROTARY)
12. _____ VIN (Record from left, use door post label)
13. _____ ENGINE FAMILY NUMBER OR CODE
14. _____ TRANSMISSION TYPE (M3, M4, M5, M8, AT)
15. ____ U.S.A. SPECIFICATION LABEL (N,Y,?)
16. _____ A LABEL STATES CATALYST (NL = no label, Y = label indicates CAT, N = label does not list cat, 9 = label obscured, 2W, 3W, 2W3)
17. ____ CATALYST CONDITION on INSPECTION (Ø,Y,4,5,6,7,9,?)
18. _____ CARB BARRELS (Ø,1,2,3,4,?)
19. _____ CARB ORIGINALLY HAD SEALS OR CAPS (LC = limiter caps, S = seals, ?)
20. _____ SEALS OR CAPS CONDITION (Ø,N,Y,4,6,7,8,9,?,Z)
21. _____ FUEL INJECTION (Ø, MP = multi-port, TB = throttle body, Y,Z,B,D,H)
22. _____ TURBO (Ø,N,Y,?,B,D,P)
23. ___ EGR VALVE OR SENSOR (Ø,Y,1,3,4,5,6,7,9,?)
24. ___ CLOSED LOOP COMPUTER FEEDBACK (Ø,Y,2,6,9 = motorist reports problems)
25. ____ O_2 SENSOR (Ø,Y,2,4,7,9,?)
26. ____ ENGINE CHECK LIGHT (Ø,Y, ON, ?)
27. ____ PCV (Ø,Y,1,3,4,5,6,7,9,?)
28. ____ THERMOSTATIC AIR CLEANER (Ø,Y,1,3,4,5,6,7,9,B,INV = inverted, SPD = Stovepipe disconnected)
29. ____ EVAP CANNISTER (Ø,Y,3,4,5,6,7,9,?)
30. ____ AIR PUMP (Ø,Y,4,5,6,7,9,?)
31. ____ AIR PUMP BELT (Ø,Y,7,8,9,?)
32. ____ AIR INJECTION, ASPIRATION, PULSE AIR SYSTEM (Ø,Y,4,5,6,7,9,?)

IDLE EXHAUST EMISSIONS MEASUREMENT RESULTS

33. LOW _____ RPM 33a. HIGH _____ RPM
34. _____ HC (PPM) 34a. _____
35. ____.____ CO (%) 35a. ____.___
36. _____ EXHAUST SYSTEM INTEGRITY (Y, EL = leaks, 4,6,7)
37. _____ FUEL CAP (Y,6,7,9)
38. _____ FUEL CAP SEAL (Y,6,7,9,?,Z)
39. _____ FUEL INLET RESTRICTOR (Ø,Y,1,4,6,7,?)
40. _____ TANK FUEL LABEL (ØY,7,9 = painted over)
41. _____ DESIGNATED FUEL TYPE FROM TANK LABEL (L = none = leaded, U = Unleaded, DF = Diesel)
42. _____ FUEL SAMPLE TAKEN (N,Y)
43. _____ PLUMBTESMO LEAD TEST RESULTS (PP = Positive, NP = Negative)
44. COMMENTS

_____

45. _____ VACUUM SPARK RETARD - SPARK SYSTEM (Ø,Y,1,3,4,5,6,7,8,9,?)
46. _____ IDLE STOP SOLENOID (Ø,Y,1,2,3,4,6,7,8,9,?)
50. _____ OWNER MAINTENANCE INFORMATION
51. _____ FOLLOWS MANUFACTURER'S MAINTENANCE SCHEDULE (Y, N, PARTIAL, DOES NOT KNOW)
52. _____ DATE OF LAST NON-BODY REPAIRS
53. _____ YEARLY TUNE UP (Y, N, DOES NOT KNOW)
54. _____ SIZE (SUB-COMPACT, COMPACT, MID-RANGE, FULL)
55. _____ INSPECTOR'S OVERALL MAINTENANCE ASSESSMENT

FIGURE B.1 SURVEY FORM

Unfortunately there is no definitive list for equipment on all vehicles of the Canadian in-use fleet and the situation is further complicated by USA Specification vehicles of the same model, imported into this country which do not fit the above description. A partial list of vehicles and control equipment was prepared by Environment Canada and Transport Canada and although it can serve as a guide for the 1980 to 1985 model years, there is no substitute for a knowledgeable inspector/mechanic. Equipment on "U.S. Specification" vehicles can be identifed from the Colorado State listing(7).

B.3 DESCRIPTION OF ITEMS ON THE SURVEY FORM

For all items on the survey form a data recorder may prefer (for accuracy) to enter a written description rather than one of the codes listed in Table B.1. The following describe the items listed on survey forms, Figure B.1

80. **Number** (Record Number, I.D. Number). Vehicles are numbered sequentially as they are inspected. This number should be preceded by a site or city identifying letter. If more than one test lane is used a lane number could also be included to identify the analyzer used to measure idle emissions. Example: M2999 = Montreal clinic, lane 2, vehicle 999.

90. **Date.** Record the date the vehicle is inspected.

100. **Location.** The location of the clinic.

110. **Inspector.** The Inspector/Mechanic adds their name or initials.

1. **Make.** The full name or common abbreviation of the vehicle manufacturer. For certain large manufacturers both the company division and parent name may be included. Example: Buick-GM.

2. **Model or Series.** Record the model name plus any identifying numbers and letters.

3. **Model Year.** Vehicle model year. Sources in order of preference: decode from the VIN; list from the vehicle door post label; ask the driver.

4. **License Plate.** Province abbreviation.

5. **Vehicle Type.** Coded as: C = car, T = truck.

6. **GVWR.** Gross Vehicle Weight Rating in pounds, 6a. - lbs, or - kilograms, Kgs. After the clinic the data may be further refined to indicate categories of light or heavy truck.

7. **Odometer.** Check off 7a. - miles or - kilometres and record the odometer reading in thousands. Ask the driver to confirm the odometer mileage particularly with older vehicles.

8. **Dash Label.** Displays the fuel required. A check mark or Y on this item indicates there is a dash label still on the vehicle. Note there is no legal requirement for a dash label and therefore it cannot be used as proof of fuel type.

9. **Fuel Used - Asked Motorist.** Ask the driver what fuel they normally use in the vehicle. Coded: L = leaded gasoline, U = unleaded gasoline, UL = combination or alternates leaded and unleaded, A = alcohol blend, AL = alternates leaded gasoline and alcohol blend, AU = alternates unleaded gasoline and alcohol blend, CNG = compressed natural gas, DF = diesel fuel, M = neat methanol, PR = propane, Z = other (add to 44. Comments).

10. **Displacement.** Record the value listed on the underhood label. Check either 10 - CID (cubic inches displacement) or - Litres.

11. **Number Cylinders.** Coded as: 1, 2, 3, 4, 5, 6, 8, 10, 12, or 99 = a rotary engine.

12. **VIN.** Record the number on the driver's side of the dash under the windshield or on the driver's door post. Always record beginning at the left. Since 1980 all VIN are 17 characters long and the 10th character from the left indicates the model year, Table B.2.

13. **Engine Family Number or Code.** As recorded on an underhood label. The engine family codes are usually alpha-numeric but vary drastically by manufacturer. Prior to the clinic, have inexperienced data recorders check a number of sample vehicles.

14. **Transmission Type.** Coded: MT = manual transmission, M3 = manual 3 speed, M4 = manual 4 speed, M5 = manual 5 speed, M8 = dual range manual, AT = automatic transmission. A breakdown of the number of automatic transmission speeds has been dropped because of the confusing designators employed by some manufacturers although the codes A2, A3, A4 and AO = Automatic with overdrive have been retained.

15. **U.S.A. Specification Label.** Record: N = No; Y = Yes, a label states U.S. specification; or ? = cannot find the label.

16. **A Label States Catalyst.** The vehicle was originally catalyst equipped - as listed on a label. Coded: NL = no label; Y = Yes, there is a label which indicates a catalyst; N = there is a label, but it is without a catalyst indication; 9 = there is a label but it has been too damaged to read; 2W = 2-way oxidation catalyst is indicated; 3W = 3-way catalyst; 2W3 = 2 catalysts - 1 is a 2W and the other a 3W; or ? = label is confusing.

    The Catalytic Converter, 2-way, oxidizes the HC and CO to water and CO_2 in the exhaust gas. Later model catalysts, 3-way, also reduce oxides of nitrogen as well.

17. **Cat Condition on Inspection.** Assign the code for the observed condition of the Catalytic Converter, including whether it is missing or by-passed. Normally this is just a check or a Y indicating that the catalyst is on the vehicle and connected. Since most catalysts are encased in stainless steel they are often in "better" condition than the rest of the exhaust system and little can be determined with respect to performance deterioration from an external examination.

18. **Carb Barrels.** Coded: Ø, 1, 2, 3, or 4 barrel, or ? = the vehicle has a carburetor but the number of barrels could not be determined.

19. **Carb Originally Had Seals or Caps.** Indicate whether the vehicle was originally equipped with either seals or limiter caps on the carburetor. Coded: LC = the vehicle was originally equipped with (plastic) caps on the adjustment screws to limit carburetor adjustments; S = the vehicle was originally equipped with metal plugs or seals to prevent engine parameter maladjustment; ? = the seals or caps cannot be seen. Although most U.S.A. specification vehicles with carburetors had seals for the 1982 Model Year and on, there is no such certainty for Canadian specification models. Therefore, a careful examination by an experienced inspector is essential.

20. **Seal or Caps Condition.** Assign the code for the observed condition of the carburetor limiter caps or seals. Since there is no law restricting the removal of caps or seals, the U.S. EPA classes cap or seal removal as "arguably tampered" i.e., they are missing but the adjustments may be at the correct settings. Do <u>not</u> class limiter cap removal from 1973 and older vehicles as tampering since they were frequently removed by the dealers prior to sale.

21. **Fuel Injection.** Coded: Ø = not originally equipped with fuel injection; MP = multi-post fuel injection; TB = throttle body fuel injection; Y = yes, fuel injection but cannot discern the type; H = hybrid system.

22. **Turbo.** Is the vehicle equipped with a turbocharger?

23. **EGR Valve or Sensor.** The Exhaust Gas Recirculation (EGR) System directs a portion of the exhaust gases back into the cylinders to reduce NO_x emissions in the exhaust gas. The standard EGR configuration consists of a vacuum line from the carburetor or throttle body to a sensor (the cold temperature override switch-CTO-used to detect engine operating temperature to activate the EGR valve), and another vacuum line from the sensor to the EGR valve. Assign the code for the observed condition of the EGR valve, sensor and hoses.

24. **Closed Loop Computer Feedback.** Coded: Ø or Y to indicate whether the vehicle is equipped with a computer system; or 9 = the motorist reports having problems with his computer system.

25. **O_2 Sensor.** Normally the Oxygen Sensor is located on or near the exhaust manifold and provides an indication of the oxygen concentration in the exhaust gases. This information allows for more precise control of the air-fuel mixture going into the engine of vehicles equipped with three-way catalytic converters. Record whether a vehicle is equipped with an oxygen sensor and its observed condition. A vehicle may have an O_2 sensor even though it does not have a catalytic converter, but all closed loop computer feedback systems will have O_2 sensors.

    NOTE: The location and condition of the O_2 sensor may be difficult to determine.

26. **Engine Check Light.** Is the vehicle equipped with an engine checklight and is it on. Coded: Ø = not originally equipped; Y = the vehicle has an engine check light but it is not on; ON = the vehicle has an engine light and it is on.

27. **PCV.** Positive Crankcase Ventilation (PCV) system - prevents crankcase emissions by purging the crankcase of blowby gases which leak between the piston rings and the cylinder wall in the combustion chamber under high pressures. Assign the code for the observed condition of the PCV system.

28. **Thermostatic Air Cleaner.** The Heated Air Intake provides warm air to the carburetor during cold engine operation. Assign the code for the observed

condition of the thermostatic air cleaner system. Additional codes: SPD = the stovepipe hose is missing, full of holes or is disconnected; INV = the top cover of the air cleaner has been inverted.

29. **EVAP Cannister.** The Evaporative Control System (ECS) captures vapors from the fuel tank and carburetor. Some systems have only two connecting hoses: from the fuel tank to the cannister, and from the cannister to the carburetor or air cleaner (for purging the cannister). Other systems have a third line connected to the carburetor. Many cannisters are concealed in the fender wells. Assign the code for the observed condition of the EVAP Control System.

30. **Air Pump.** Air Injection Systems extend the combustion process into the engine's exhaust system by injecting fresh air into the exhaust ports, lowering exhaust emissions while still maintaining proper vehicle performance. These systems are also used on some catalyst equipped vehicles to supply extra oxygen to increase catalyst efficiency. Two types of air injection systems are currently used. One type uses a belt-driven air pump to direct air through a control valve and into the exhaust manifold. The other type is a Pulse Air Injection Reaction (PAIR) system, which uses an aspirator located in the air cleaner to supply air to the exhaust manifold. Air Pump for the purposes of this report, consists of the air pump and control valve. Assign the code for the observed condition of the air pump.

31. **Air Pump Belt.** Assign the code for the observed condition of the air pump belt.

32. **Air Injection, Aspiration, Pulse Air System.** Assign the code for the observed condition of the non-air pump, air injection system.

33. **Idle Exhaust Emissions Measurement Results.** 33. - Low. 33a. - High. Record the rpm readings at which the low and high idle exhaust emission measurements are recorded.

34. **HC (ppm).** Exhaust gas HC concentration (in ppm) at 34. - low idle and 34a. - high idle.

35. **CO (%).** Exhaust gas CO concentration (in percent) at 35. - low idle and 35a. - high idle.

36. **Exhaust System Integrity.** The condition of the exhaust system is coded. EL = leaks or the system has major leaks.

37. **Fuel Cap.** The fuel cap seals the fuel tank and prevents evaporative emissions during normal operating conditions. Record if the cap is present.

38. **Fuel Cap Seal.** Inspect the rubber or plastic seal to see if it is intact. Use "?" if the seal is present but is condition is doubtful.

39. **Fuel Inlet Restrictor.** (unleaded vehicles only) - The restrictor is designed to prevent the introduction of a larger leaded fuel nozzle into a vehicle requiring unleaded fuel. It may be difficult to detect tampering by visual inspection, a dummy leaded nozzle or gauge inserted into the inlet provides a positive test.
NOTE: Some vehicles have restrictors but do not have catalytic converters. However, if the vehicle was originally equipped with a catalyst it must also have had a restrictor and tank label.

40. **Tank Fuel Label.** Displays the required fuel. Record whether the label is still present. If present, but it has been painted over use code 9. The label is not always fixed to the outside surface of the vehicle, it may be necessary to obtain a key from the driver in order to check inside a locked covering door.
NOTE: If a vehicle was originally equipped with a catalyst then it must have also had an "unleaded fuel only" tank label, but the converse is not always true (Section B.2.2).

41. **Designated Fuel From Tank Label.** Record the fuel type listed on the Tank Fuel Label. Coded: L = leaded fuel or unleaded fuel use NOT indicated, U = unleaded gasoline, DF = diesel fuel.

42. **Fuel Sample Taken.** Indicates whether a fuel sample for later lead analysis was taken.

43. **Plumbtesmo Lead Test Results.** Plumbtesmo paper is used to check for the presence of lead deposit in a vehicle exhaust pipe. PP = positive. A positive indication is a change to pink or violet coloration and indicates a reaction to lead. NP = Negative. No reaction on the plumbtesmo paper is recorded as negative.
NOTE: The white paper turns yellow when moistened, within 30 seconds to 1 minute the yellow colour begins to fade back to white. White or yellow colours are considered a negative reaction. See Section C.3.0.

44. **COMMENTS:** A blank line is provided on the form to record anything unusual about the vehicle or any qualifications with respect to the test results.

45. **Vacuum Spark Retard - Spark System.** Record the code for the observed condition. Because of troubles with identification, this item has been dropped from recent EPA surveys.

46. **Idle Stop Solenoid.** Record the code for the observed condition. Because of troubles with identification, this item has been dropped from recent EPA surveys.

50. **Owner Maintenance Information.** Record any information the driver/owner may volunteer regarding recent repairs, engine changes, etc.

51. **Follows Manufacturer's Maintenance Schedule.** Ask the driver/owner whether he adheres strictly to the maintenance schedule as outlined in the owner's manual.

52. **Date of Last Non-Body Repairs.** Ask the driver/owner.

53. **Yearly Tune Up.** Ask the driver/owner whether they take the vehicle for a yearly tune-up.

54. **Size.** Enter the unofficial size: sub-compact, compact, mid-range, full size.

55. **Inspector's Overall Maintenance Assessment.** Enter, inspector/mechanic's general comments or code: RAF - requires new air filter; REM - requires engine maintenance; RFM - requires air/fuel adjustment.

TABLE B.2 VIN - MODEL YEAR CODES

Year	Code*
1980--	A
1981--	B
1982--	C
1983--	D
1984--	E
1985--	F
1986--	G
1987--	H
1988--	J
1989--	K
1990--	L
1991--	M
1992--	N
1993--	P
1994--	R
1995--	S
1996--	T
1997--	V
1998--	W
1999--	X
2000--	Y
2001--	1
2002--	2
2003--	3
2004--	4
2005--	5
2006--	6
2007--	7
2008--	8
2009--	9
2010--	A
2011--	B
2012--	C

* For 1981 and newer vehicles, the Model Year character in the VIN is the 10th character in the VIN reading from the left. Since 1981 all Vehicle Identification Numbers, VIN, have been 17 characters long.

APPENDIX C
RECOMMENDED TEST PROCEDURES

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APPENDIX C
RECOMMENDED TEST PROCEDURES

C.1.0 INTRODUCTION

The inspection procedures described herein may be used at inspection clinics in order to attempt to identify in-use motor vehicles which are emitting hydrocarbons and carbon monoxide at levels in excess of specified limits and to detect emission control component tampering plus misfuelling. Technologically feasible exhaust emission limits have also been included, Table C-1[8].

In developing this procedure Environment Canada conducted numerous inspection clinics, in cooperation with provincial Departments of the Environment, Energy or Highways, in order to demonstrate the feasibility of in-use vehicle emissions inspections.

In the absence of maltuning, component failure, deliberate tampering or misfuelling, vehicles are capable of emitting HC, CO and NO_x at or below the levels prescribed in the Motor Vehicle Safety Act for much of their useful life. A simple idle exhaust emissions test and tampering check procedure may be used to identify those vehicles which have defective, missing or disabled pollution control equipment; which are "extremely" high emitters of hydrocarbons and carbon monoxide; and which may have been misfuelled. Restorative maintenance on these vehicles will have the effect of reducing exhaust emissions and, to a lesser degree, reducing fuel consumption. NO_x and evaporative emissions are not measured as part of the idle emissions test procedure but the tampering check includes NO_x and evaporative emission control equipment.

C.1.1 TERMINOLOGY

In the text:

- "CO" is carbon monoxide;
- "% CO" is the percent of carbon monoxide by volume in the vehicle exhaust;
- "exhaust analyzer" refers to an apparatus capable of measuring hydrocarbons in parts per million and carbon monoxide in percent of undiluted exhaust gas;
- "HC" is hydrocarbon;
- "ppm HC" is parts per million hydrocarbons in the vehicle exhaust measured as hexane;

- "in-use motor vehicle" is any passenger car or light truck that is licenced to operate on public roads;
- "underhood label" refers to a decal placed in the engine compartment that specifies certain engine parameter adjustments that are recommended by the manufacturer (e.g., spark timing, idle speed, idle mixture, etc.) there may also be diagrams or tables indicating vacuum hose routing and the emission control hardware installed on the vehicle;
- "vehicle age" is the age of a vehicle in years referenced to the model year of manufacture. Thus, in 1985, a 1982 model year vehicle is classified in the 3 year old class, while a 1975 model is classified in the 10 year old class.

C.2.0 COMPONENT INSPECTION AND EXHAUST EMISSIONS TEST PROCEDURE

Because of the number and variety of emission control components that can be installed on any particular vehicle, a complete description of the visual component tampering check procedure is not contained herein. Those involved in operating inspection clinics are referred to the Survey Form (Appendix B), to published information and to the emission control component illustrations in Appendix D.

It is assumed that a vehicle entering the test lane has been operating for some time, ten minutes minimum, and is at its operating temperature (i.e., warmed up). Emissions at cold start are not representative of "warmup" idle emissions. To ensure that the test vehicle is at its operating temperature, it is suggested that the next car waiting in line be kept running until tested.

The suggested steps to inspect and test at the level of clinic complexity designed IX in Table 3 of the main text are as follows: (for personnel designations see Appendix A).

C.2.1 INITIAL STEPS

1) The greeter (B) provides the designated literature to the driver while the vehicle is waiting and requests a signature on any waivers. To avoid driver frustration the greeter should inform motorists as to how long they must wait.
   The waiting vehicle remains outside the test area at least one car length from the vehicle being tested.

2) When the test lane is empty, the driver is asked to position the vehicle in the desired location in the test area.

3) The driver is asked to leave the vehicle running and to remain inside. The vehicle transmission should be in PARK (automatic transmission) or NEUTRAL (manual transmission). As noted earlier, there could be problems connected with engaging the PARKING BRAKE, therefore for safety reasons it may be best to ask the driver to keep the PEDAL BRAKE engaged at all times while the engine is running.

4) The driver is requested to release the hood from inside, if so equipped.

C.2.2 IDLE EXHAUST EMISSIONS TEST

5) A designated person inspects the vehicle's exhaust system for major leaks. If major exhaust system leaks are observed, the driver should be advised that this portion of the clinic work cannot be performed and that exhaust system repairs are required.
NOTE: If there is a long wait for a test, it may save driver frustration to have the "greeter" check a vehicle's exhaust system while it is waiting outside the test area or when it first enters the waiting line.

6) If component function tests are to be included in the clinic they should be performed at this time.

7) If the vehicle exhaust system is in good repair proceed to step 8, if not go to step 13.

8) The inspector/mechanic (E) places the fender apron on the vehicle, connects tachometer and checks the scale of the exhaust analyzer. This procedure assumes that the instrument has been correctly calibrated employing the procedures recommended in Appendix E.

9) A sample line or probe is inserted at least 0.3 meters (12 inches) into the tailpipe. In the case of dual exhaust, either tailpipe can be selected.
WARNING - Recheck that the vehicles transmission is in PARK or NEUTRAL.

10) Increase engine speed to the high idle position, 2500 rpm, for at least 60 seconds or until CO and HC readings have stabilized. Record the CO and HC concentrations.
WARNING - At no time while the engine is running should personnel lean over or near the vehicle's engine fan. Lean over the vehicle from the side only. It is also advisable for the Inspector/Mechanic and the data recorder to wear ear muff hearing protectors.

NOTE: The engine speed may be raised to 2500 rpm either by having the mechanic manipulate the throttle from inside the engine compartment or by having the driver use the throttle pedal to bring the engine to the desired speed. Both techniques were employed successfully during the June, 1986 clinic in Montreal. The mechanic initiated method provides greater accuracy and control, but requires the mechanic to handle (and possibly damage) vehicle components plus usually requires the tachometer to be inside the engine compartment. The driver initiated method allows less contact with the vehicle and involves the motorist in the testing, but requires an easily readable tachometer and may take longer to test as the driver experiments with pedal control.

11) Allow the engine to return to low idle. Record stabilized readings of CO, HC and the engine idle rpm.

12) Disconnect the test equipment and remove the exhaust probe.

13) The driver should be requested to shut off the vehicle leaving the transmission as required in step 3. Place the fender apron on the vehicle if not already in place.

C.2.3 COMPONENT TAMPERING CHECK AND DATA GATHERING

14) The Inspector/Mechanic (E) in conjunction with the data recorders, (C) and/or (D), inspects the affixed vehicle labels for the required information. The Inspector/Mechanic uses a listing or an affixed label to determine the emissions control components that were originally installed on the vehicle.

15) The Inspector/Mechanic, assisted by other members of the team, begins a visual inspection of the emission control components for signs of tampering, or damage. A designated person asks the motorist pertinent vehicle information such as: mileage, model year, fuel used, etc.

16) A designated person performs the lead sensitive paper test on the tailpipe. (See Section C.3.0). This person also asks the driver for the fuel cap key in order to check the condition of the inlet restrictor. For correct verification as to the condition of the fuel inlet restrictor a dummy leaded-fuel nozzle or gauge is recommended.

17) If a fuel sample is to be taken the designated person would extract the sample at this time. (See Section C.4.0).

C.2.4 FINAL STEPS

18) The person responsible for data gathering ensures that the data recorders have completed all of the sections of the Survey Form or Forms, then collects and stores the completed forms. A fresh set of survey forms are then provided to the data recorder(s).

19) The designated person should inform the vehicle driver as to the test results and to the state of the emissions control equipment on the vehicle. The driver may be told the emissions readings for their car and be provided with a test results form.

20) The designated person checks that the exhaust probe and the tachometer have been removed from the vehicle. The same person thanks the motorist for participating in the clinic and advises them to restart the vehicle, to release the parking brake and to leave the enclosure at a safe speed.

21) Prepare the site for the next vehicle.

C.3.0 LEAD SENSITIVE PAPER (PLUMBTESMO) APPLICATION PROCEDURES

A. Equipment: 4 litre container of rinse water, 1 litre squirt bottle, tweezers or clothes pins, plastic gloves, test paper.

B. Check a sample of the test paper from a new box (or each morning) with the rinse water to detect possible contamination. Distilled or de-ionized rinse water is preferred if available. Tap water may be used, but there is a risk of contamination. The dry white paper should turn yellow when moistened

C. Clean a portion of the inside of the tailpipe (exhaust pipe) large enough for the test paper by wiping it out with a paper towel or cloth. This may be necessary to remove soot deposits which might mask the color change. Some researchers feel this step is not required and that the paper may be applied directly to the interior of the pipe without a preparation step.

D. Moisten the white Plumbtesmo paper with rinse water (the paper should turn yellow) and immediately* press firmly against the surface to be tested for approximately

*Note: The Plumbtesmo paper must be applied during the time that the paper is yellow for the reaction to take place. After approximately 15 seconds the yellow color begins to fade and the paper is no longer effective. Excess water also interferes with the reaction.

thirty seconds. If the tailpipe is hot and to avoid contamination a clamp may be used to fix the test paper in the tailpipe. Discardable clothes pins are suggested.

Care must be taken to avoid contamination of the test paper. If a person has recently handled a test paper with a positive reaction, some lead or reactive chemical may have been transferred to their fingers. Subsequently handling a clean test paper may cause contamination. Use a new glove(s) and a new clamp for each vehicle.

E. Remove the test paper and determine whether a color change has occurred. Red or pink coloration is considered a positive reaction and indicates the presence of lead. A violet coloration is an indication of a "strong" positive reaction. If the paper remains white or yellow (or black because of soot from the tailpipe) then the reading is recorded as negative or no lead deposited on the tailpipe.

F. One source of Plumbtesmo paper is:

Aldert Chemicals Ltd.
648 Finch Ave. East
Willowdale, Ontario, M2K 2E6
(416) 223-0404

C.4.0 FUEL SAMPLE COLLECTION AND LABELLING PROCEDURES

If a fuel sample is taken from "unleaded fuel only" vehicles, the samples should be collected in four-ounce bottles with a hand-operated fuel pump. Once the sample is drawn, the fuel is replaced with an equivalent amount of unleaded fuel if the driver requests, and the pump is flushed with unleaded fuel.

Each bottle should be identified with an adhesive label that has the vehicle identifying survey number on it. The vehicle identifying number is one of the first entries on the data forms.

C.5.0 EXHAUST EMISSION LIMITS, CUTPOINTS OR EVALUATION CRITERIA

It is most desirable to refer to the manufacturer's idle emissions specifications for allowable CO and HC concentrations in the exhaust as specified on an underhood label. (Note, in practice very few vehicles have these labelled cutpoints.) Label values represent the ideal settings for a particular vehicle. Since, in reality, some increase in emissions is expected as a result of normal engine wear as the vehicle ages, the limits

specified on the label may be extended at the rate of 0.1% per year of vehicle age for %CO and 30 ppm per year of vehicle age for ppm HC.

Where a label value is not available, the emission limits illustrated may be used, Table C-1. For each vehicle tested there are four emissions limits, high and low idle for HC plus high and low idle for CO.

TABLE C-1 SUGGESTED IDLE EXHAUST EMISSIONS TEST LIMITS**

	2 500 RPM				IDLE			
	6 & 8 Cylinder		4 Cylinder		6 & 8 Cylinder		4 Cylinder	
Vehicle Age	CO %	HC ppm	CO %	HC ppm	CO %	HC ppm	CO %	HC ppm
0-1***	1.0	200	1.5	200	1.5*	300	2.5*	300
1	1.1	230	1.6	230	1.6	330	2.6	330
2	1.2	260	1.7	260	1.7	360	2.7	360
3	1.3	290	1.8	290	1.8	390	2.8	390
4	1.4	320	1.9	320	1.9	420	2.9	420
5	1.5	350	2.0	350	2.0	450	3.0	450
6	1.6	380	2.1	380	2.1	480	3.1	480
7	1.7	410	2.2	410	2.2	510	3.2	510
8	1.8	440	2.3	440	2.3	540	3.3	540
9	1.9	470	2.4	470	2.4	570	3.4	570

* The existing MVSA new vehicle emission levels for the idle test.
** To be used if the manufacturer's specifications are not available.
*** Present model year.

Care must be exercised when judging a vehicle's emissions performance if it exceeds the idle standards, since many errors of "commission" (failing a vehicle which would pass a Federal Test Procedure (FTP) mass emission test) have been documented.(3)

As discussed earlier, there can be considerable error in relating idle exhaust emissions test results to FTP results and it is unadviseable to set failure criteria with respect to idle emissions measurements. Idle exhaust emissions measurements can only reliably detect emissions which are much in excess of FTP standards, i.e., Idle

measurements which are 2 times or greater than the HC and CO idle exhaust emissions limits shown in Table C-1. Emissions of either HC or CO in excess of the emission limits should be reported to the driver as "high, but acceptable", "very high, check with your dealer" or some similar phrase, rather than report that the vehicle has failed.

C.6.0 OPTIONAL INSPECTIONS AND PROCEDURES

Other inspections which could be added to the test procedure to supply additional data on vehicle maintenance plus useful information to the motorist are:

- battery terminal corrosion,
- head lamps, tail lamps,
- belts,
- hoses,
- coolant level,
- oil level engine,
- fluid level transmission,
- brake fluid level,
- tire pressure,
- tire wear.

Underinflated tires increase tire wear and increase fuel consumption and hence emissions. Therefore a tire pressure check is a wise addition to any program.

C.7.0 AN EXPLANATION OF TAILPIPE EXHAUST EMISSIONS MEASUREMENTS

C.7.1 CARBURETOR SYSTEMS

Tailpipe, idle exhaust emissions readings are difficult to interpret, but levels well above those listed by the manufacturer or the test limits are probably indicative of the need for adjustment or maintenance of components. Hydrocarbon (HC) and Carbon Monoxide (CO) measurements of vehicle tailpipe (exhaust) gases are usually made at both normal (low idle) and high, 2500 rpm, idle speeds.

Carbon Monoxide in the exhaust gases is an indicator of the richness of the fuel/air mixture burned in the combustion chamber. Very high idle CO readings usually indicate too rich a mixture (i.e., too much fuel) and show the need for idle mixture adjustment. This condition may also mean that the idle speed may have to be reset. A high CO reading at 2500 rpm usually indicates a malfunction in the fuel mixing system.

This condition could result from a high carburetor float level, a worn fuel inlet seal and needle or clogged air bleeds. If readings are considerably above those listed by the manufacturer or the test limits (2 times or more), the car would benefit from a "tune up" and carburetor adjustments. Following these repairs a small (1-3%) improvement in fuel economy could be expected along with a considerable decrease in the tailpipe emissions of CO.

High hydrocarbon levels in the exhaust gases can be caused by either: 1) a rich mixture in which case CO readings would also be high; 2) high oil consumption and poor engine mechanical condition or 3) misfire from: a) a vacuum leak in one of the vacuum hoses or the intake manifold; b) a faulty electrical system, either spark plugs, points, distributor cap or rotor; c) too lean or too rich a mixture at idle.

C.7.2 FEEDBACK FUEL SYSTEMS

If a vehicle is equipped with a computer-controlled feedback fuel system, high CO or HC levels generally mean a serious computer, oxygen sensor, or fuel/air mixture problem. This condition could lead to large fuel economy penalties or driveability problems. A vehicle in such a state should be checked by a garage or dealer familiar with the system on the car.

APPENDIX D
VEHICLE EMISSIONS CONTROL COMPONENTS

D.1.0 EMISSION CONTROL EQUIPMENT-U.S. VEHICLES

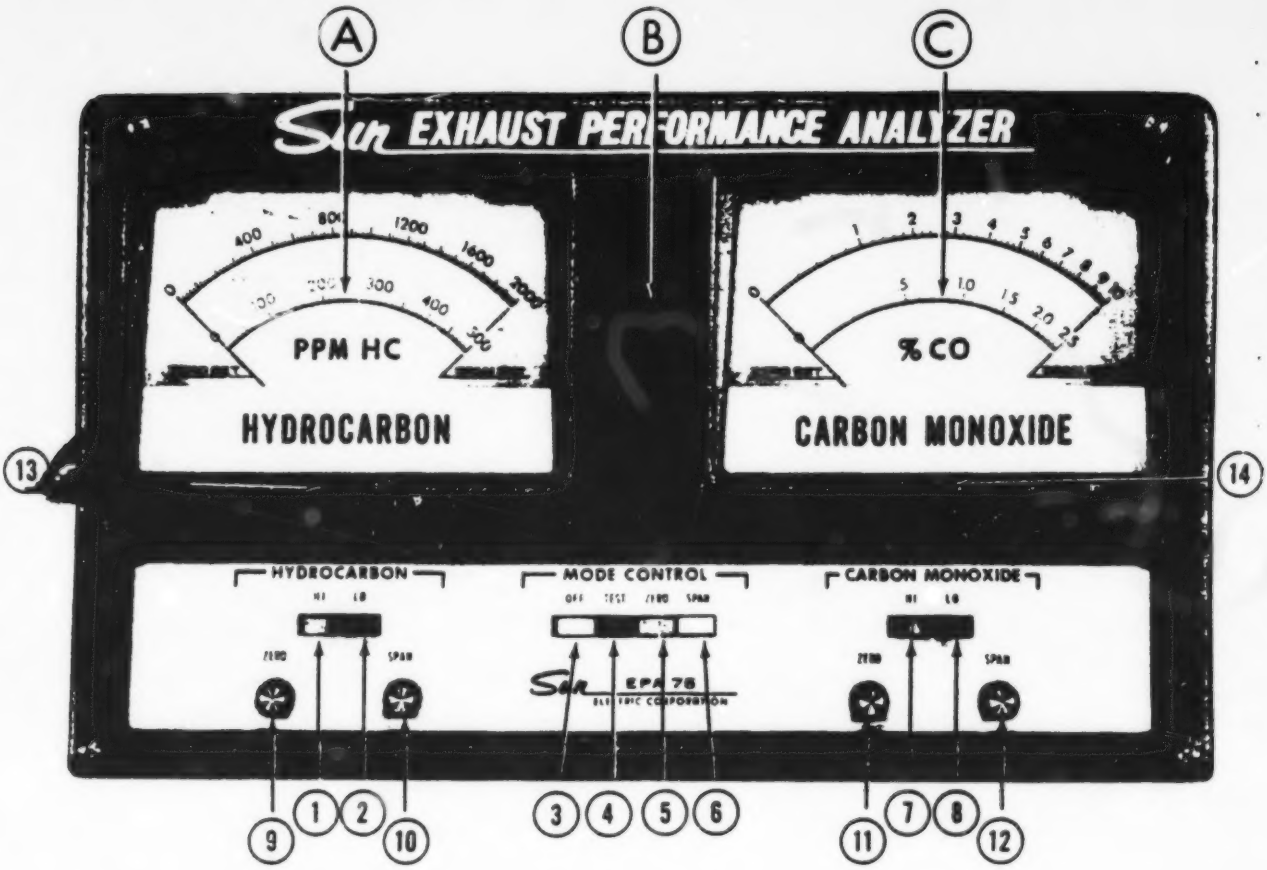
For light duty motor vehicles manufactured in the U.S.A. a listing of emission control equipment by make, model and engine size is available[7]. This listing may be used for all vehicles in the Canadian in-use fleet clearly labelled "U.S. SPECIFICATION".

D.2.0 EMISSION CONTROL EQUIPMENT-CANADIAN VEHICLES

Examples of the many equipment combinations for emission control equipment on Canadian light-duty motor vehicles are illustrated in Figure D-1. Examples of the specific components are shown in Figure D-2. For a more complete description see Reference 6.

Environment Canada and Transport Canada personnel have prepared a listing of emission control equipment on motor vehicles for the years 1980 to 1985 (available on request). It must be stressed that this list is only intended as a guide and is neither complete nor legally binding.

For vehicles in the Canadian in-use fleet of model year 1974 and earlier, the Colorado State University listing is recommended[7].



METERS & INDICATOR

A. Hydrocarbon meter - 2 color-coded scales.
B. "Low Flow/Check Filter" indicator - (lights if filters or sample hose is restricted).
C. Carbon Monoxide meter - 2 color-coded scales.

HYDROCARBON - PUSH BUTTONS

1. "HI" sets HC meter to read on Blue 0 - 2000 PPM scale.
2. "LO" sets HC meter to read on Red 0 - 500 PPM scale

MODE CONTROL - PUSH BUTTONS

3. "OFF" - Turns tester off
4. "TEST" - Turns tester on in test function
5. "ZERO" - Turns tester on to Zero meter function
6. "SPAN" - Depress and hold while adjusting meters to "SPAN SET" line (Low Flow Check Filter indicator should light as a check on the light)

NOTE:

Pushing the SPAN set button automatically places meter circuitry in LO position while depressed.

CARBON MONOXIDE - PUSH BUTTONS

7. "HI" sets CO meter to read on Blue 0 - 10% scale
8. "LO" sets CO meter to read on Red 0 - 2.5% scale.

ROTATING CONTROLS

9. "Zero" - Sets HC meter to Zero set line.
10. "Span" - Sets HC meter to Span set line
11. "Zero" - Sets CO meter to Zero set line
12. "Span" - Sets CO meter to Span set line.

METER MECHANICAL ZERO

13. Adjusts Mechanical Zero of HC Meter
14. Adjusts Mechanical Zero of CO Meter

FIGURE E.1 SUN TWO GAS ANALYZER

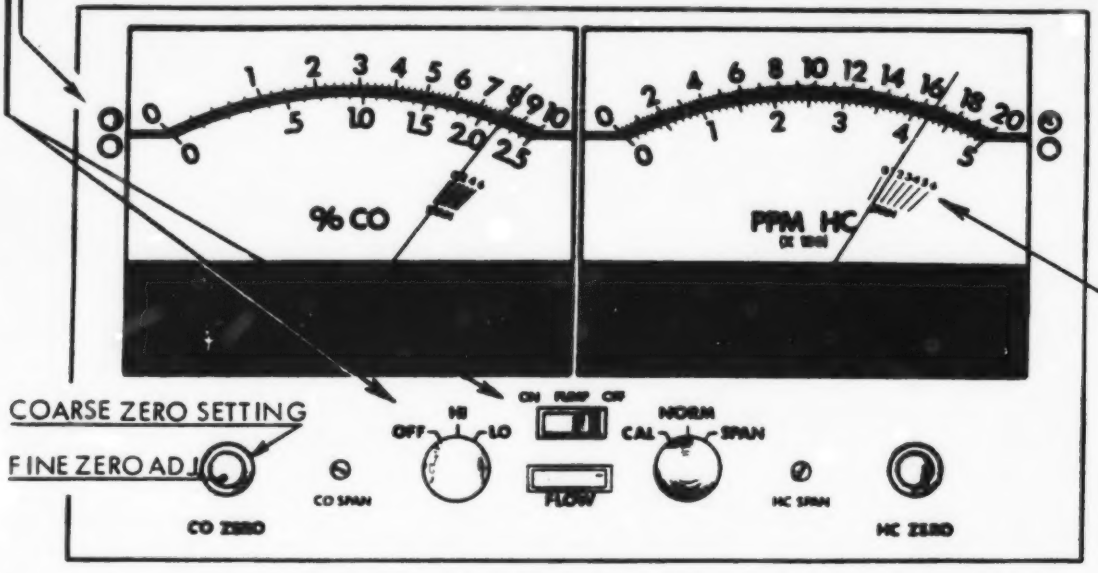
1. Plug power cord in a reliable 110V. wall outlet.

2. Switch power and pump on.
   The meter scale indicator light should now be "on" depending on which scale the selector is indicating (HI-LO).

If meter indicator lights do not come on, check circuit breaker on the back panel. If meter indicator lights flicker or go on and off, double check power outlet or extension cord connections if used.

3. Allow analyzer to stabilize for at least 15 minutes. Needle fluctuations are normal during warm up.
   Flow light should now be on.

If flow light does not come on:
1. Make sure the pump switch is in the ON position.
2. Check flow (see page 16).



CALIBRATION AND PERFORMANCE CHECK. After 15 minutes warm-up.

1. With analyzer sampling fresh air, zero CO and HC scales with selector in NORM or CAL position. Use outside knob for coarse and inside knob for fine zero adjust.
2. Turn calibration knob to SPAN and read the span scale. See table below.
3. Results: SPAN CORRECT -Return selector to NORM and proceed.
   SPAN INCORRECT -Adjust the CO span and/or HC span with a small screwdriver to the applicable altitude.

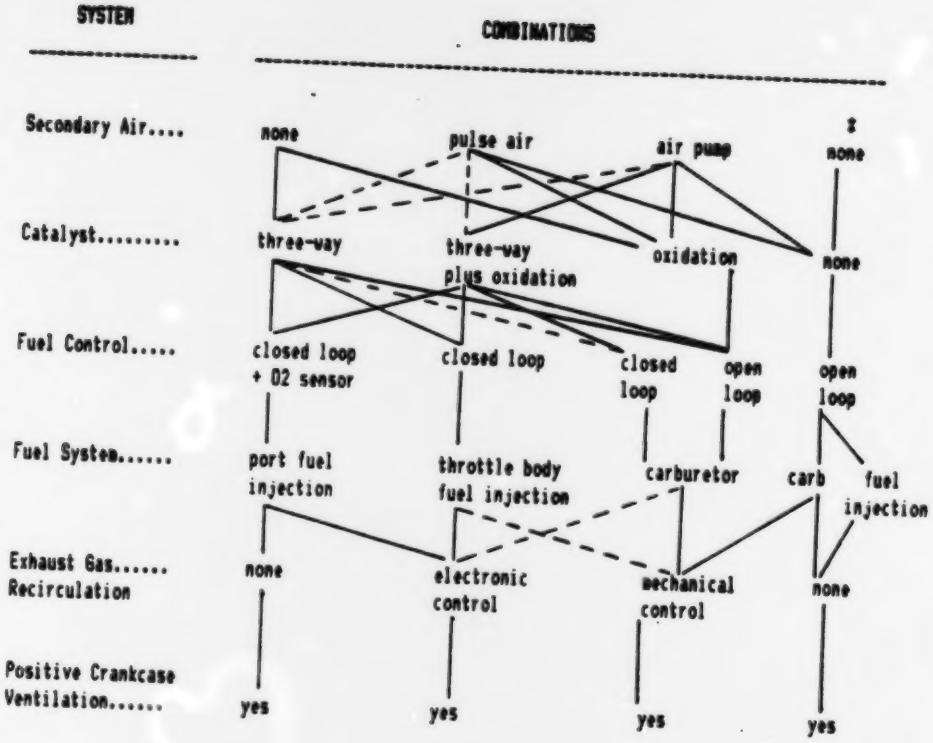
FOR CALIBRATED GAS VERIFICATION - SEE PAGE 31

Span Setting

The higher the altitude the lower the density. No calculation is required to compensate since the scale is screened directly on the meter face. Set the span according to altitude per 1000 ft

Altitude	Setting
0 - 1000 ft.	Between 0 - 1
1000 - 2000 ft.	Between 1 - 2
2000 - 3000 ft.	Between 2 - 3 etc.

FIGURE E.2 ALLEN TWO GAS ANALYZER



- - - - relatively unusual combination

evaporative emissions control and thermostatic air not included

‡ In Canada only, for model years 1981 through 1987

FIGURE D-1 EMISSION CONTROL TECHNOLOGY COMBINATIONS AVAILABLE IN CURRENT MARKET

E.G.R. VALVE Since 1973, E.G.R. Valves have been standard on most domestic vehicles. The E.G.R. Valve which is the heart of the E.G.R. system reduces harmful oxides of nitrogen, or NOx, produced during combustion. This is accomplished by reintroducing carefully calibrated amounts of exhaust gas which slows down combustion and thus reduces the amount of NOx produced. Malfunctioning of the E.G.R. valve will result in bad fuel economy, hard starting at all temperatures, rough idle, poor acceleration and loss of engine power.		***SOUPAPE R.G.E.*** *Depuis 1973, les soupapes R.G.E. (recirculation des gaz d'échappement) ont été d'usage standard sur la plupart des véhicules domestiques. La soupape R.G.E. qui est le coeur du système réduit les oxydes nocifs de nitrogene, ou NOx, qui sont produits au cours de la combustion. La réduction des gaz nocifs se fait en réintroduisant des quantités soigneusement calibrées de gaz d'échappement, lesquelles ont pour but de ralentir la combustion et par conséquent de réduire la quantité d'oxyde de nitrogene produite. Un mauvais fonctionnement de la soupape R.G.E. occasionnera une mauvaise économie d'essence, des difficultés de démarrage à toutes les températures, un fonctionnement inégal du moteur à la vitesse de ralenti, une piètre accélération et une perte de la puissance du moteur.*
E.G.R. VACUUM AMPLIFIER The E.G.R. Vacuum Amplifier is used to more precisely control the opening and closing of the E.G.R. Valve. Venturi vacuum controls a series of diaphragms inside the amplifier to regulate the amount of manifold vacuum applied to the E.G.R. Valve. The E.G.R. Vacuum amplifer can develop a leak or a ruptured diaphragm inside the amplifier which would permit fresh air to enter the intake manifold. These leaks lean out the air/fuel mixture, causing hard starting or rough engine idle. Amplifier leaks can also cause loss of powerbraking.		***AMPLIFICATEUR DU VIDE R.G.E.*** *L'amplificateur du vide R.G.E. est utilisé pour contrôler avec plus de précision l'ouverture et la fermeture de la soupape R.G.E. Le vide du venturi contrôle une série de diaphragmes à l'intérieur de l'amplificateur pour régulariser la quantité du vide du collecteur d'admission, qui est appliquée à la soupape R.G.E.* *L'amplificateur du vide R.G.E. peut devenir défectueux à la suite du développement d'une fuite ou à la suite d'une rupture du diaphragme à l'intérieur de l'amplificateur, ce qui permettrait à de l'air frais d'entrer dans le collecteur d'admission. Ces fuites auraient pour résultat d'appauvrir le mélange air/essence, occasionnant par le fait même des démarrages difficiles ou un fonctionnement inegal du moteur. Des fuites en provenance de l'amplificateur peuvent aussi causer la perte de puissance du système de servo-freins.*
PORTED VACUUM SWITCH When an engine is cold, recycling exhaust gas can cause missing and stalling. Until the engine warms up, the Ported Vacuum Switch is closed to stop the vacuum signal before it reaches and opens the E.G.R. Valve. A malfunctioning of the P.V.S. can cause premature opening of the E.G.R. Valve and cause bad starting when cold, rough idle, poor acceleration and stalling.		***COMMUTATEUR DE VIDE À ORIFICE*** *Quand un moteur est froid, la recirculation des gaz d'échappement pourrait occasionner des ratés ou entraîner l'arrêt subit du moteur. Aussi longtemps que le moteur n'a pas atteint sa température normale de marche, le commutateur de vide à orifice demeure fermé pour arrêter le signal du vide avant qu'il n'atteigne et n'ouvre la soupape R.G.E. Un mauvais fonctionnement du commutateur de vide à orifice peut occasionner l'ouverture prématurée de la soupape R.G.E. et occasionner des difficultés de démarrage pendant les temps froids, une marche inegale à la vitesse de ralenti, une piètre accélération et un arrêt subi du moteur.*
SPARK DELAY VALVE Spark delay valves are used to restrict distributor vacuum advance to minimize the formation of NOx. These valves are color coded to indicate the proper delay time for each vehicle as specified. Spark delay valves cannot be repaired and must be replaced every 12,000 miles because the pores of the sintered metal disc inside the valve fill with dust which can slow the advance and thereby degrade engine performance. A defective valve will cause rough engine idle and increase fuel consumption.		***SOUPAPE DE RETARDEMENT DE L'ALLUMAGE*** *Des soupapes de retardement de l'allumage ont pour fonction de restreindre l'avance à vide du distributeur, afin de réduire au minimum la formation de NOx. Ces soupapes sont codées en couleurs pour indiquer le temps de retardement adéquat selon les spécifications recommandées pour chaque véhicule. Les soupapes de retardement de l'allumage ne peuvent pas être reparées et par conséquent elles doivent être remplacées à tous les 20 000 km, etant donné que les pores du disque metallique agglomeré, qui est à l'intérieur de la soupape, se remplissent de poussière, ce qui peut occasionner un ralentissement de l'avance de l'allumage et par conséquent réduire le rendement du moteur. Une soupape de retardement de l'allumage qui devient défectueuse peut occasionner un fonctionnement inegal du moteur à la vitesse de ralenti et augmenter la consommation d'essence.*

FIGURE D-2 EMISSION CONTROL COMPONENTS

E.G.R. SPACER PLATE

Most Ford E G R Valves are mounted on a Spacer Plate which channels the exhaust gas from the crossover passages through the E G R Valve and back to outlet ports under the carburetor. This plate should be removed, cleaned and checked at regular E G R service intervals. Cracked, burned or badly plugged plates should be replaced, to ensure proper engine performance.

PLAQUES D'ÉPAISSEUR R.G.E.

La plupart des soupapes R G E de Ford sont montees sur une plaque d'épaisseur qui canalise les gaz d'échappement venant des passages transversaux et les dirige a travers la soupape R G E pour ensuite les retourner vers des orifices de sortie localises en dessous du carburateur. Cette plaque doit être enlevée, nettoyee et verifiee a des intervalles reguliers d'entretien du systeme R G E. Des plaques fissurees, grillees ou lourdement bouchées devraient etre remplacees, afin d'assurer un rendement adequat du moteur.

CHOKE THERMOSTAT

The Automatic Choke contains a bi-metal spring which contracts with cold temperatures and closes the choke valve. This "Chokes" the engine by cutting the air supply to the carburetor, thus enriching the fuel air mixture which enables the engine to overcome its cold temperature handicap during starting and warm up. A defective Choke Thermostat can cause poor starting, stalls, spark plug fouling and excessive gas consumption.

THERMOSTAT DE VOLET DE DÉPART

Le volet de départ automatique comprend un ressort bilame qui vient en contact avec les temperatures froides et ferme le volet de départ. Ceci «etrangle» le moteur en empêchant l'arrivee d'air au carburateur ce qui permet d'enrichir le melange carburant-air et au moteur de surmonter son handicap de temperature froide pendant le demarrage et la periode de rechauffage. Un thermostat de volet de départ defectueux peut provoquer des mauvais demarrages, des calages, un encrassement des bougies et une consommation excessive d'essence.

CHOKE PULL-OFF

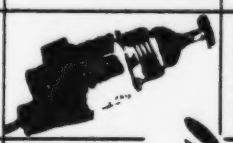
The Choke Pull-Off's function is to monitor the engine vacuum to "feather" the choke opening in response to engine requirements, preventing stalls and hesitation from over-choking. A defective Pull-Off can cause poor starting, stalls, spark plug fouling and excessive gas consumption.

RAPPEL DU VOLET DE DÉPART

La fonction du rappel du volet de départ est de contrôler la depression du moteur afin d'ouvrir progressivement le volet de départ en reponse aux besoins du moteur, ce qui l'empêche de caler et d'hesiter par suite d'un volet de départ fermé. Un rappel defectueux peut provoquer des mauvais demarrages, des calages, un encrassement des bougies et une consommation excessive d'essence.

THROTTLE HOLDING SOLENOID

The Throttle Holding Solenoid eliminates "dieseling" or "engine after-run" by closing the throttle past the normal engine idle position when the ignition switch is turned off. Malfunctioning of this control will cause dieseling which can cause engine damage.

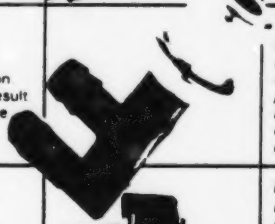


SOLÉNOÏDE D'OBTURATEUR

Le solenoide d'obturateur élimine l'effet de «diesel» ou «d'auto-allumage» en fermant l'obturateur apres la position normale de ralenti du moteur lorsque le contact est ferme. Un mauvais fonctionnement de cette commande peut provoquer l'effet de diesel et endommager le moteur.

P.C.V. VALVE

The purpose of the PCV Valve is to control the circulation of combustion blow-by gases from the crankcase to the intake manifold, where they are reburned, thus preventing air pollution. A dirty or blocked PCV Valve can cause poor engine idle and result in crankcase contamination which may cause excessive engine wear and costly repairs.



SOUPAPE DE RECYCLAGE DES GAZ DU CARTER

Le but de la soupape de recyclage des gaz du carter est de contrôler la circulation de la combustion des gaz provenant du carter du moteur dans la tubulure d'admission ou ils sont rebrûles, empêchant ainsi la pollution de l'air. Une soupape de recyclage des gaz d'échappement bouchee ou sale peut causer un mauvais ralenti du moteur et une contamination du carter du moteur, ce qui peut causer une usure excessive du moteur et des reparations coûteuses.

CRANKCASE VENTILATION FILTER

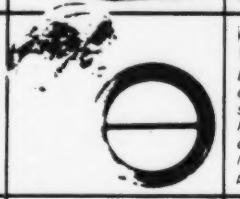
The Crankcase Ventilation Filter is a dual purpose filter which filters the excess combustion gas from the crankcase that is by passed by the PCV Valve during high speed operation. It also filters the dust laden air which enters the crankcase from the unfiltered side of the air cleaner. Thus a dirty crankcase filter contributes not only to air pollution, but also causes crankcase contamination.

FILTRE DE VENTILATION DU CARTER

Le filtre de ventilation du carter est un filtre a deux buts qui filtre l'exces des gaz de combustion provenant du carter du moteur qui sont déviés de la soupape de recyclage d'échappement pendant les regimes rapides. Il filtre également les poussieres contenues dans l qui entrent dans le carter du moteur du côte non filtre du filtre a air. Un filtre de carter du moteur sale contribue donc non seulement a polluer l'air mais également à contaminer le carter du moteur.

CHARCOAL CANISTER FILTER AND CARTRIDGE

The purpose of the Charcoal Canister Filter is to trap and filter out normal fuel tank gasoline vapors. The Canister Filter is located at the bottom of the American Motors, Chrysler, and General Motors Canister. It filters the incoming air which purges gas vapors from the canister. A dirty or plugged filter prevents the full volume of air through the canister causing rough idle and excessive emissions.



CARTOUCHE FILTRANTE ET ABSORBEUR DE VAPEURS D'ESSENCE

Le but de cet absorbeur est d'emprisonner et de filtrer les vapeurs d'essence en provenance du reservoir de carburant. L absorbeur est situé au fond des cartouches American Motors, Chrysler et General Motors. Il filtre l'air d'arrivee qui purge les vapeurs de gaz de la cartouche. Un absorbeur sale ou bouche empêche un passage total de l'air au travers de la cartouche et provoque un ralenti mauvais et une pollution excessive.

TEMPERATURE SENSOR

The Temperature Sensor is the bi-metal control valve for the heated air cleaner system used on most 1968 to 1982 automobiles. Its purpose is to close the air inlet damper valve on the air cleaner snorkel when the engine is started, allowing preheated air from a manifold heat stove to pre-warm the carburetor. It re-opens the snorkel damper when the proper engine temperature is reached. An improperly operating sensor will cause rough idle and stalling during warm up and poor high speed performance.

THERMOCONTACT

Le thermocontact est une soupape de commande bilame pour le systeme de nettoyage de l'air chauffe utilise sur la plupart des automobiles, modeles 1968 a 1982. Son but est de fermer le volet de commande d'arrivee d air du filtre a air lorsque le moteur est mis en route, permettant a l air prechauffe provenant du volet de pre chauffage du carburant de rechauffer le carburateur. Il rouvre le volet de commande du filtre lorsque la temperature adequate du moteur est atteinte. Un thermocontact qui ne fonctionne pas correctement provoquera de mauvais ralentis et des calages pendant la periode de rechauffage ainsi que de mauvaises performances a vitesses rapides.

FIGURE D-2 EMISSION CONTROL COMPONENTS (Cont'd)

APPENDIX E
EXHAUST GAS ANALYZERS

APPENDIX E - EXHAUST GAS ANALYZERS

E.1.0 ANALYZERS

Illustrations of two makes of EPA-75 two-gas emissions analyzers have been reproduced from the manuals, Figures E.1 and E.2.

There are many brands of EPA-75 analyzer in service: (unranked list):

ALLEN GROUP
AUTOSENSE
BEAR
FMC
HAMILTON TEST
PEERLESS
SUN

NOTE: No particular make is recommended and the mention of trade names or commercial products in this report does not constitute endorsement for use.

When operating one of these analyzers in the field it is important to carefully read the manufacturer's instructions and operate as directed. The analyzers take 20 to 30 minutes to warm up or stabilize and therefore should be switched on first at the start of each test day. Switch on and calibrate all analyzers including the back-up. Do not switch off during the day's clinic operations unless so directed in the operating instructions. Allow the instrument to warm up before attempting to calibrate. At the completion of each day's tests disconnect and drain the sample line and probe. Replace the particulate filters and drain the water trap if required. After the last test allow the analyzer to run 20 minutes (sample line disconnected) to purge.

N.B.: If the analyzer has both high- and low-range scales, ensure that data recorders check the range which is set each time they record readings. When taking an emission reading at a particular rpm, allow the reading to stabilize for 10 to 15 seconds, but take the readings before 30 seconds since some vehicles, particularly FORD products, shut off the injection air after approximately 30 seconds operation at idle. In high-moisture situations it may be necessary to drain the water trap and change filters frequently. Be sure to have a supply of replacement filters available.

E.1.1 PROBE

The probe fits on the end of the sample line. The sample line should be a minimum of 6 m (20 ft) in length in order to reach from the analyzer, at the left front, to

the tailpipe exit, at the right rear, of larger automobiles. The exhaust probe must be inserted a minimum of 0.3 m (1 ft) into the tailpipe. The probe should be at least 0.3 m to 0.6 m of flexible hose for inserting into curved or bent tailpipes. Either side of a dual exhaust may be sampled. A thin probe should be used for trucks with spark shields.

E.1.2 NULL READINGS

If no emissions register on the analyzer check the following:

1- check the type of vehicle - it could just have very low emissions.
2- check the analyzer scale - switch to lowest scale.
3- check that the analyzer is in the TEST MODE not the zero mode.
4- check for kinks or knots in the sample line.
5- check the analyzer "low flow" lights.

E.2 CALIBRATION

In order to obtain "best" results from an idle exhaust emissions test it is essential that the exhaust gas analyzer be functioning properly and be accurately calibrated. The preferred calibration schedule is as follows: prior to being used at a clinic, an analyzer should be cleaned and purged and subjected to a span gas calibration check using at least 3 span gases plus a "zero" gas check. This bench test could be performed either in an agency's laboratory or the instrument could be returned to the manufacturer or supplier for calibration.

In the field, every morning before use, the analyzer should first be checked to see that all filters are in good condition and that the inlet is unblocked. Ensure that all water is drained from the sample line before turning on the analyzer. A calibration check is then performed. The minimum requirement is a check of the meter's mechanical zero (or meters' for most 2 gas analyzers) plus a check of the electrical zero and span which are provided on most analyzers. However, the preferred daily procedure when time and resources allow is to calibrate each morning using a bottled calibration gas. First, check the zero of the CO and HC scales by allowing the analyzer to sample ambient air (there should be little measurable CO or HC if the analyzer is away from vehicles and other obvious emission sources). Follow the zero check with a span check on the HC and CO scales using the bottle of calibration gas provided for such purpose. If an instrument fails to span or zero correctly, switch to the spare analyzer.

E.2.1 ZERO GAS

For a laboratory zero check of an analyzer use either "zero air" or nitrogen, N_2, which have been certified as analyzed for CO, total HC and any other interferents as listed in the manufacturer's specifications.

If a zero gas is not available or for field calibration, disconnect the sample line and allow the instrument to sample ambient air. This check should be performed in an area well removed from any exhaust emissions. Ensure that the analyzer inlet is off the ground and that the instrument is allowed sufficient time to purge itself prior to the zero calibration.

E.2.2 SPAN GAS

For the span check of an analyzer in a laboratory the use of 3 span gases is recommended:

- 8% CO, 1560 ppm HC (Hexane or equivalent, usually propane) in N_2
- 4% CO, 827 ppm HC (Hexane or equivalent, usually propane) in N_2
- 1.6% CO, 320 ppm HC (Hexane or equivalent, usually propane) in N_2.

Hexane is the recommended HC span gas, but is rarely available. Propane is normally used by the instrument suppliers and each instrument lists a conversion or multiplication factor for converting the propane span reading to the correct hexane reading. The ratio of propane to hexane is approximately 2:1 and the multiplication factor ranges from 0.490 to 0.560 - check the instrument manual!

For a span check in the field, a single span gas is recommended:

- 1.6% CO, 320 ppm HC (Hexane or equivalent, usually propane) in N_2. This will normally allow the instrument to be checked on both the high and low scale.

One source of span gases is the local suppliers of the exhaust analyzer. Be certain to order the gases well in advance of the clinic start date.